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BASIC NOISE RESEARCH PROGRAM

- FAN NOISE -

EFFECT OF INLET DISTURBANCES ON FAN INLET NOISE DURING A STATIC TEST

by K.L. Bekofske, R.E. Sheer, and J.C.F. Wang

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16. Abstract

Measurements of fan rotor inlet noise taken during static test situations are at variance with aircraft engine flight data. In particular, static tests generally yield a significantly higher tone at blade passage frequency than that measured during flight. An experimental program was carried out to investigate this discrepancy. The main objective of this program was to provide data which would determine the extent of the influence of inlet ground vortices and large-scale inlet turbulence on the forward-radiated fan noise measured at a static test facility. While such inlet disturbances were generated intentionally in an anechoic test chamber, far-field acoustic measurements and inlet flow-field hot-film mappings of a fan rotor were obtained. Experimental results indicate that the acoustic effect of such disturbances appears to be less severe for supersonic than for subsonic tip speeds. Further, a reverse flow that occurs on the exterior cowl in static test facilities appears to be an additional prime candidate for creating inlet disturbances and causing variance between flight and static acoustic data.

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Section 1

SUMMARY

There is evidence that forward radiated fan noise data taken during static test situations do not agree with aircraft engine flight data. In particular, static tests generally produce a significantly higher tone at blade passage frequency than that measured during flight. The present report describes an experimental program carried out to investigate two types of inlet disturbances which may be partially responsible for this discrepancy—large-scale turbulence and inlet vortices.

The anechoic chamber employed for these tests nominally drew air through the floor, ceiling, and all walls (except the wall in the immediate vicinity of the fan inlet duct). The baseline chamber was thus designed to provide a porous-box type of arrangement. Far-field acoustic measurements were made to determine the baseline forward radiated fan noise. In addition, a pair of cross-element hot-film probes provided measurements of the axial and transverse mean velocities and turbulence intensities of the inlet flow field ahead of the rotor. One of the hot-film probes was mounted on an actuator which allowed circumferential mapping around a 180° arc within the inlet. Similarly, inlet flow field mappings ahead of the rotor were carried out while the artificially created inlet vortices or large-scale turbulence were present, to determine the change in the flow and turbulence structure caused by these distortions. The extent of the influence of the artificially created inlet disturbances on the measured forward-radiated fan noise was obtained by direct comparison of their far-field acoustic results with the baseline measurements.

Far-field acoustic results indicated significant increases (up to 4 dB) in the blade passage tone levels for subsonic tip speeds when the distortions were present. The noise level changes were insignificant at supersonic speeds because of the domination of multiple pure tones.

The ground vortices were generated by installing a simulated ground plane directly beneath the fan inlet. The hot-film results obtained with this arrangement clearly showed the orientation and location of the incoming ground vortices and the associated increases in both axial and transverse turbulence intensities.

The large-scale inlet turbulence was achieved by eliminating the porous-box feature of the test chamber. Turbulence length scales were increased by a factor of 2 to 4 with this arrangement. Further analyses of the hot-film data showed evidence of the eddy stretching which usually occurs during static testing.

Substantial inlet distortions were also detected during the testing of the baseline, porous chamber configuration. These disturbances were attributed to a reverse flow that occurred on the exterior cowl of the test setup. Because the baseline was contaminated in this manner, the increased noise levels due to the intentionally generated disturbances were not as great as they otherwise might have been. In a follow-up program, an attempt is being made to eliminate the disturbances related to the exterior cowl.

Section 2

INTRODUCTION

The initial measurement of the acoustic signature of a developmental aircraft engine is commonly made during a static test situation. It is then normal procedure to use these data to project to an in-flight situation in order to predict the actual noise level during flight conditions. However, it has been established (Refs. 1-3) that, even with all known corrective factors (e.g., dynamic effect and atmospheric attenuation) applied to the static measurements, projections of forward radiated noise based on static tests are at variance with actual aircraft engine flight data. An example of such a projection (Ref. 1) is shown in Figure 1, where General Electric CF6-6 ground static engine data were used to predict the DC10-10 flight sound pressure levels. In the forward (inlet) quadrant, such as the approach condition shown in Figure 1, a significant discrepancy occurs. In particular, the static tests generally yield a significantly noisier blade-passage-frequency (BPF) tone and higher (harmonic) frequencies than are actually measured in flight. The difference at BPF for the low power setting shown in Figure 1 is about 8 dB. At higher speeds (takeoff conditions) the effect is generally less, about 2 to 4 dB. Since it is believed that the fan inlet noise is being reduced in going from static to flight conditions, earlier assessments of fan inlet noise based on static data have probably been misleading.

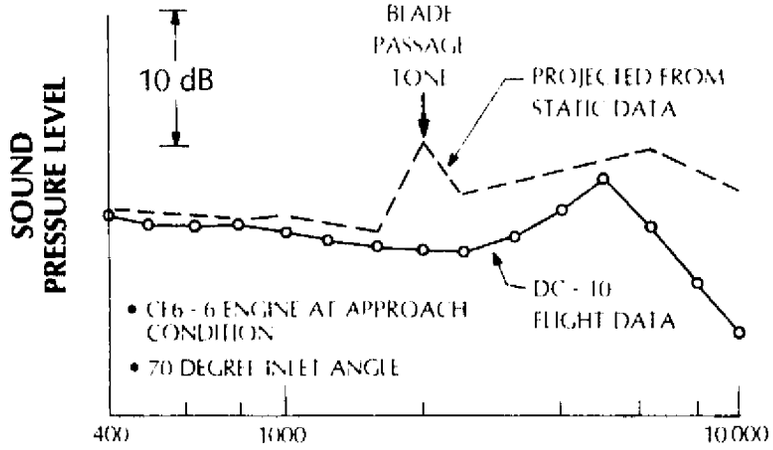


Figure 1. Comparison of Flight and Projected Static Inlet Noise Spectra[1]

There are several aspects to the impact of the incorrect evaluation of fan inlet noise levels in aircraft engines. For instance, some potentially worthwhile fan source noise reduction concepts may have been given less consideration than they deserved, or been actually abandoned, because the noise generation during static test was dominated by a source not present in flight. Some source noise reduction concepts, such as the proper selection of vane-blade ratios, increased vane-blade spacings, and vane lean, rely heavily on reducing the rotor-stator interaction as a source noise mechanism (Ref. 4). However, some negative reaction to these methods of source noise reduction may have resulted because, when they were tested statically, the fan inlet noise was dominated by the interaction of the rotor with inlet disturbances, rather than rotor-stator interaction.

A further disturbing ramification of the static-to-flight noise level discrepancy is the possible misuse of engine development funds due to the improper identification of the source of a noise problem. This might result in the investigation of a problem when, in fact, none exists.

There may be an initial opposition to all static engine acoustic tests based on the above considerations. Yet the static test remains a necessary ingredient in any fan noise reduction program, for practical as well as economic reasons. Therefore, instead of eliminating all static acoustic tests, it is important to explore and remove the causes of the static-to-flight discrepancy, with the objective to give more certainty to aircraft engine flight noise projections. Several methods of simulating flight in a static situation have been attempted (Refs. 5, 6) but to date each one seems to have its own drawbacks.

Several explanations have been given for the decrease in fan inlet noise level during flight, the so-called "in-flight effects." (The commonly used expression "in-flight effects" is actually misleading; it is the increase in noise levels during static tests, not the decrease during flight, which causes the static-to-flight discrepancy.) These explanations all relate to the widely accepted belief that the inlet flow disturbances that are ingested by the engine and interact with the rotor while it is being tested statically, leading to rotor interaction noise, do not occur or are greatly reduced during flight. Cumpsty and Lowrie (Ref. 7) demonstrated that the alteration in character of inlet disturbances with forward speed can indeed produce significant in-flight reductions of BPF tones compared with the levels recorded during static tests. Several sources have been commonly suggested for the inflow disturbances during ground static tests (Figure 2): wakes shed from test-stand supports; ambient air turbulence (including wind disturbances); and ground vortices.

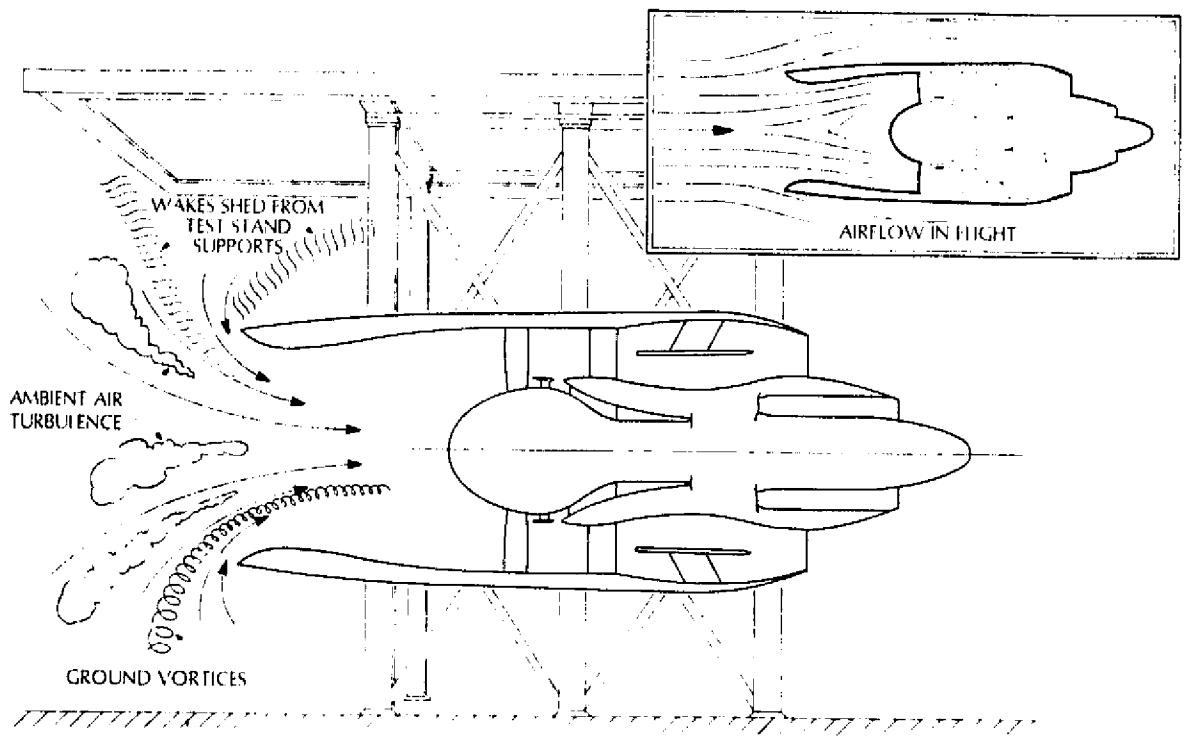


Figure 2. Inlet Flow Disturbances Which Occur During Ground Static Tests

Many researchers (Refs. 8-14) have suggested how one or more of these disturbances can lead to increases in the BPF pure tone and its harmonics. It was observed during ground static tests carried out at NASA Lewis Research Center (Ref. 8) that wakes shed by support structures can lead to substantially higher BPF tone levels. Essentially the same fan was tested in rear drive and front drive. During the front-drive installation, distortion of inlet airflow by a test-stand support structure resulted in more nonuniform inflow. Accompanying far-field acoustic measurements indicated more than a 10 dB increase in fan-generated BPF tone sound pressure level (SPL) above the cleaner rear-drive installation.

An investigation carried out at NASA Ames Research Center (Ref. 9) indicated the significance of the role played by the length scale of fan inlet turbulence on rotor-generated noise. It was found that the reduction of the ambient turbulence length scale to less than one rotor pitch was accompanied by approximately a 10 dB reduction in the sound pressure level of the BPF tone and its first harmonic. Hanson (Ref. 10– 12) has pointed out that, when an engine is being tested statically outdoors, ambient air is being drawn into the inlet from all directions as in classical sink flow. Therefore, atmospheric turbulence eddies, which are initially almost isotropic, are stretched into long, thin "sausages" of turbulence (Figure 2). Hanson has been very successful in measuring such disturbances.

These stretched eddies appear to the rotor as almost steady distortions and are a highly effective mechanism of noise generation as they interact with the rotor. This noise mechanism does not exist during flight, since air ingested by the engine originates in a comparatively small cylindrical tube ahead of the inlet, with minimal eddy stretching (Figure 2, inset). Additional experiments at NASA Ames, carried out in a wind tunnel in an attempt to simulate the effects of flight, further demonstrated the importance of inflow turbulence on fan inlet tone noise (Ref. 5). Again, an increase in the turbulence length scale was accompanied by an increase in the blade-passage-frequency SPL level.

Ground vortices, when they exist, can also produce a type of almost steady inlet distortion on the rotor. The existence and strength of ground vortices depend on such factors as inlet height above the ground and ambient wind conditions. The impact which these ground vortices have on fan inlet noise is likely to be similar to the influence of the stretched inflow turbulence described above. This has recently been demonstrated by Hodder (Ref. 14).

The experimental program described in this report was performed at General Electric Corporate Research and Development in order to further investigate some of these possible causes for the static-to-flight noise discrepancy and help answer the fundamental question of in-flight cleanup. The main objective of this program was to provide data which would determine the extent of the influence of inlet ground vortices and large-scale turbulence on the forward radiated fan noise measured at a static test facility. An aerodynamic investigation of fan inlet disturbances was performed in conjunction with acoustic measurements. While inlet ground vortices or large-scale inlet turbulence were being generated intentionally in an anechoic test chamber, far-field noise measurements were taken. In addition, by means of a specially built actuator device, circumferential and radial mappings of the inlet were carried out with hot-film equipment in order to determine the change in the inlet flow caused by such inflow disturbances.

Section 3

TEST DESCRIPTION

TEST FACILITY DESCRIPTION

The test program was conducted in an anechoic chamber at the Aero/Acoustic Laboratory of General Electric Corporate Research and Development, in Schenectady, New York. Figure 3 is a schematic diagram of the facility, and Figure 4 is a photograph showing the inside of the facility. This anechoic chamber was carefully designed to simulate free-field acoustic operation. All walls, floor, and ceiling are covered with an array of 0.71 m (28 in.) high polyurethane foam wedges, to provide less than + 1 dB standing wave ratio at 200 Hz. A distinguishing feature of the facility is that the walls, floor, and ceiling are porous. This porous-box arrangement is achieved by a manifolding system whereby flow is distributed from a filter house through 15.2 cm (6 in.) deep, U-shaped channels surrounding the chamber. The array of foam wedges is secured to the tops of the channels, and airflow enters the chamber by passing through small openings between the wedges. Such an aspirating chamber arrangement is intended to significantly reduce inflow distortion to the fan. The anechoic chamber is approximately 10.7 m (35 ft) wide by 7.6 m (25 ft) long by 3.1 m (10 ft) high, measured from the tips of the foam wedges.

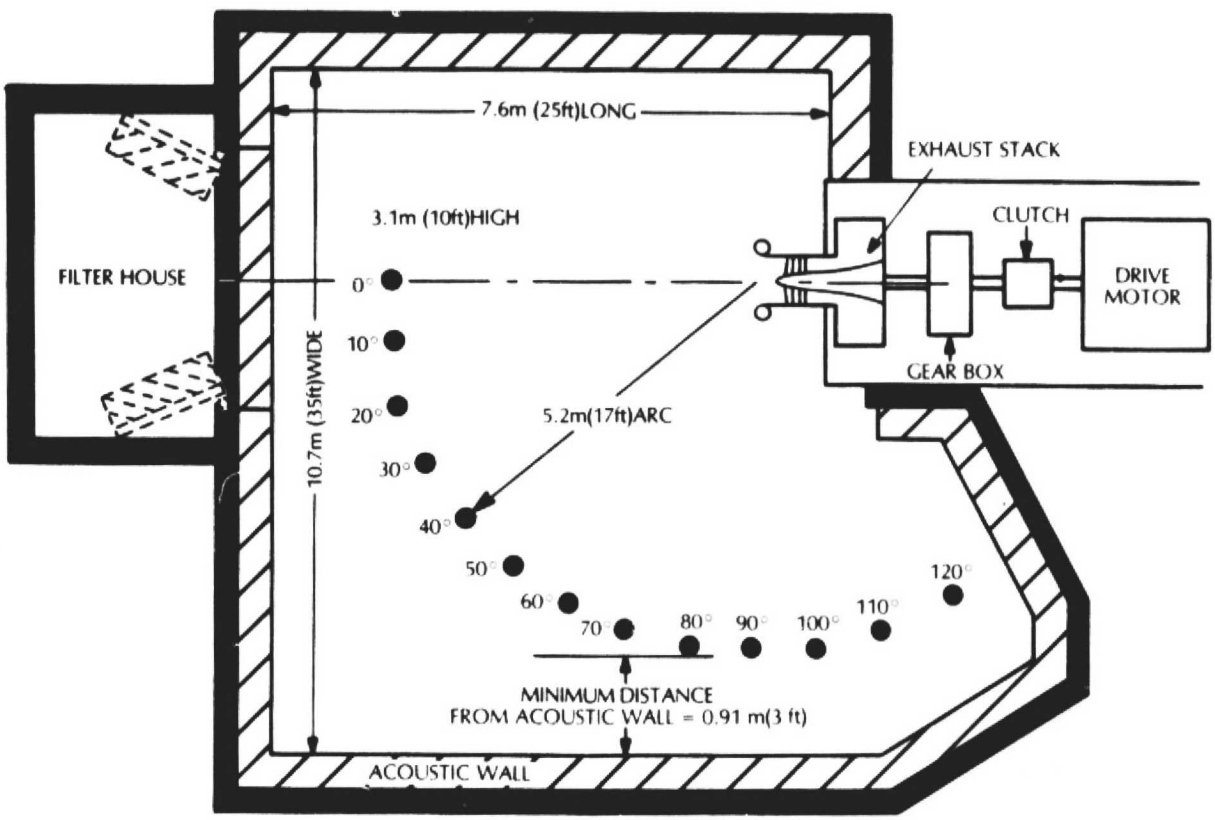


Figure 3. Schematic of the Aero/Acoustic Laboratory

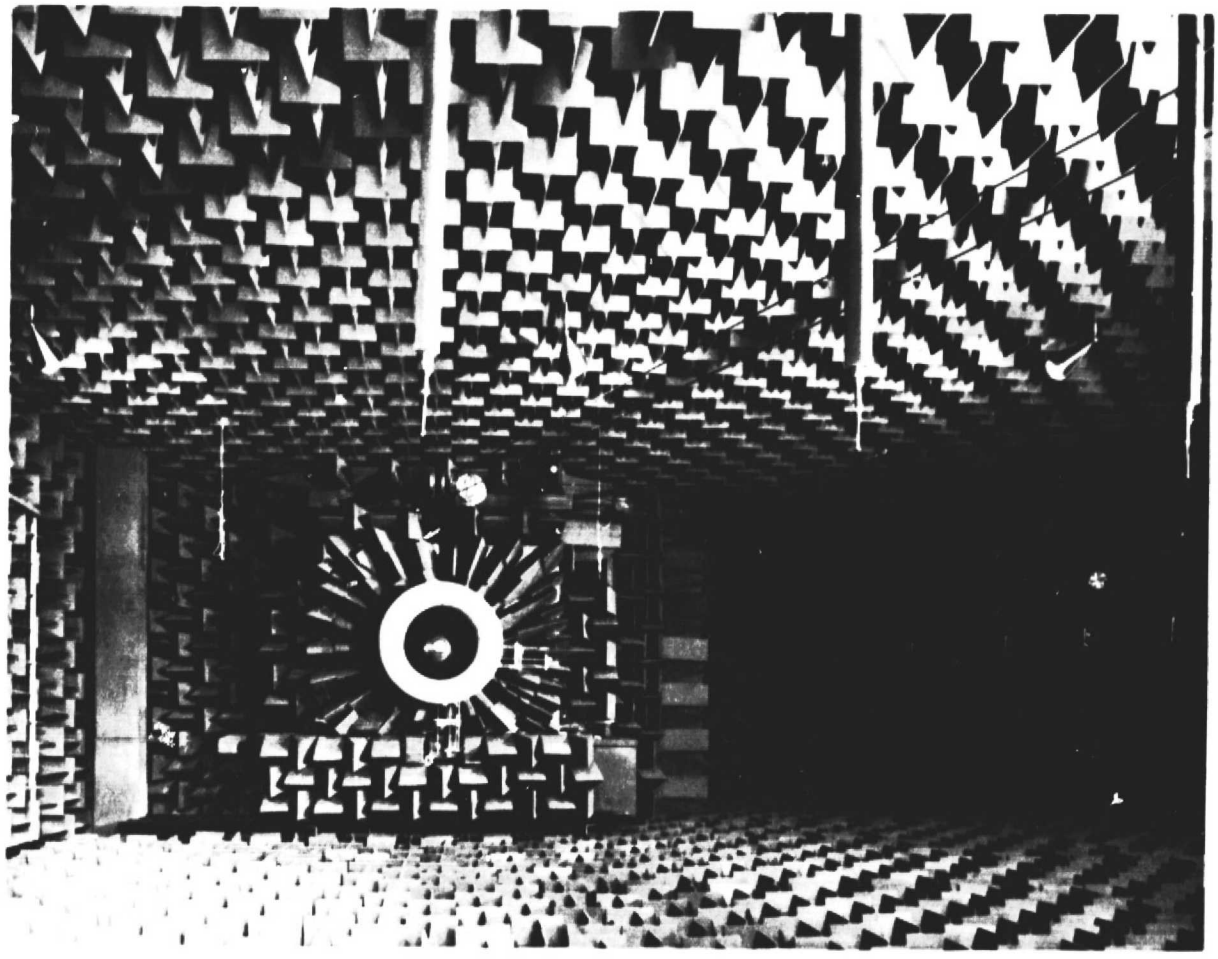


Figure 4. Overall View of the Aero/Acoustic Laboratory

The test vehicle used in this investigation was the NASA Lewis 0.504 m (20 in.) diameter fan model designated as Rotor 11. The stator set and casing were manufactured by General Electric. The overall stage has the design characteristics indicated in Table 1 and the fan performance map is shown in Figure 5. This test vehicle supplied both the air flow and sound source.

The fan inlet was a cylindrical hardwall duct with a length-to-diameter ratio of approximately 0.8. A vehicle layout drawing is shown in Figure 6. All configurations were tested with the standard GE bellmouth, shown in Figures 4 and 6.

INSTRUMENTATION

Both acoustic and aerodynamic measurements were made. The former involved anechoic chamber far-field noise measurements, which were provided by an array of twelve 0.635 cm (0.25 in.) diameter far-field microphones (B&K 4135) located on a 5.2 m (17 ft) radius arc, centered one rotor diameter upstream of the rotor front face. The microphones were arranged at 10^{o} intervals from 0^{o} to 110^{o} relative to the fan centerline (see Figure 3).

Table 1

TEST FAN STAGE DESIGN CHARACTERISTICS

Rotor Inlet Tip Diameter	0.504m (19.84in)
Pressure Ratio	1.574
Rotor Blade Number	44
Stator Vane Number	86
Vane/Blade Ratio	1.95
Inlet Guide Vanes	None
Rotor Inlet Hub Tip Radius Ratio	0.50
Rotor-Stator Tip Spacing	1.27 Rotor Chords
Rotor Rotative Speed	16100 RPM
Rotor Tip Speed	424.9 m/sec (1394ft/sec)
Rotor Tip Inlet Relative Mach No.	1.394
Rotor Chord (Midspan)	4.62 cm (1.817in)
Stator Chord (Midspan)	4.06 cm (1.597 in)
Rotor Aspect Ratio	2.5
Stator Aspect Ratio	2.3
Rotor Tip Solidity	1.298
Stator Tip Solidity	1.270
Corrected Inlet Weight Flow	29.5 Kg/sec (65 lb/sec)
Adiabatic Efficiency	85.5% (80.9% Measured)

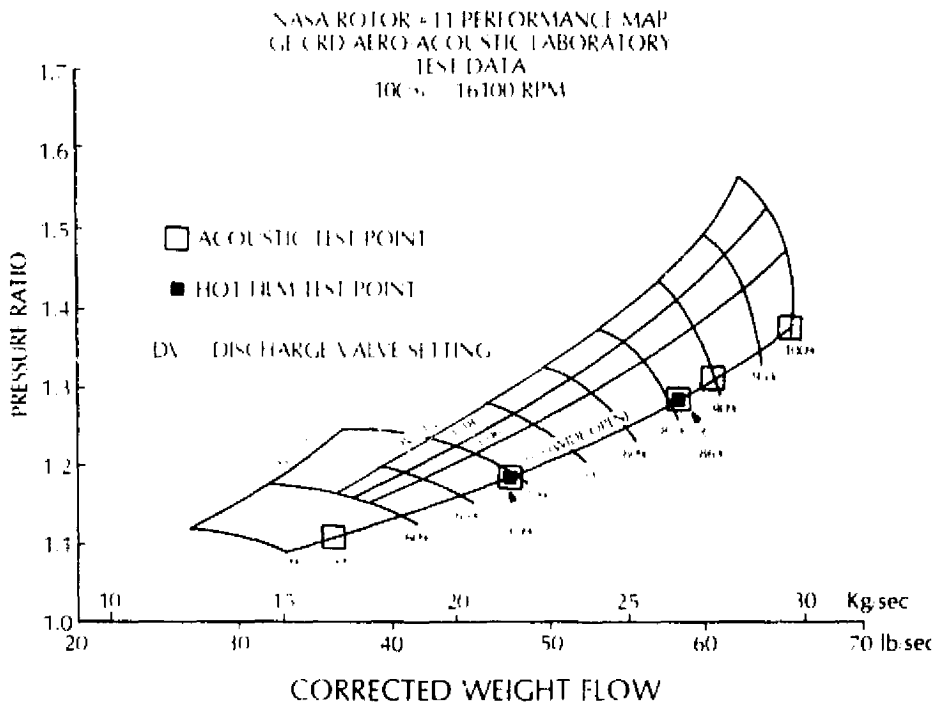


Figure 5. Test Vehicle Fan Performance Map

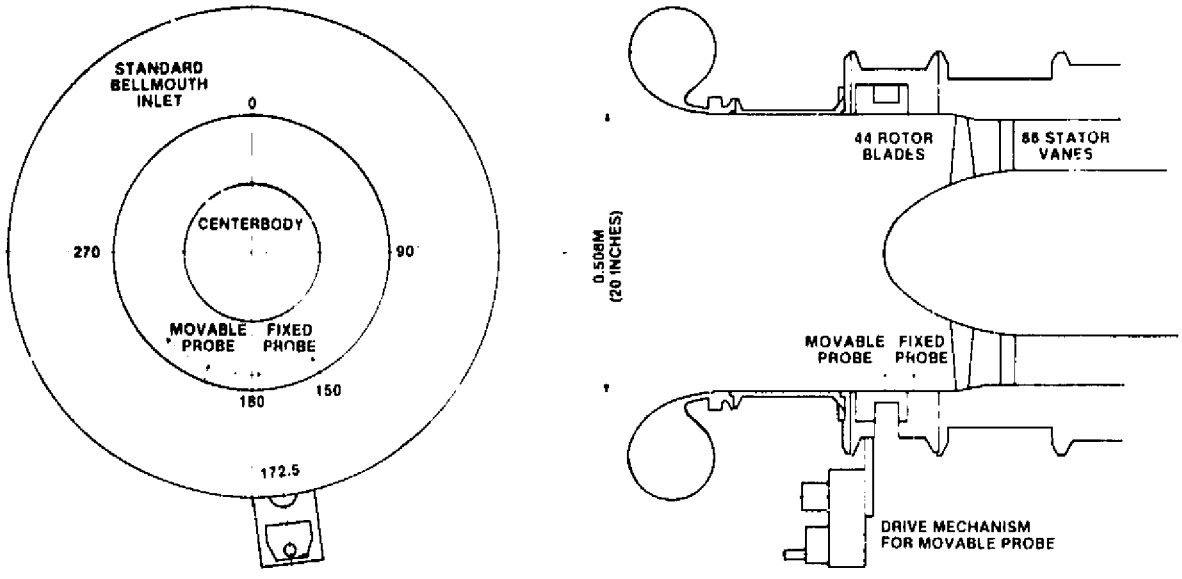


Figure 6. Test Vehicle Layout

Aerodynamic measurements were taken to determine the fan performance. The instrumentation included four total pressure/total temperature five-element rakes, located downstream of the stator, and a 0.56 m (22 in.) diameter orifice in the discharge piping to measure pressure ratio and mass flow.

Inlet turbulence was measured to provide radial and circumferential mappings of the flow approaching the rotor. Axial and transverse inlet velocities and turbulence levels were measured by cross hot-film probes (X-probes). Two X-probes were employed simultaneously during each test. One probe was mounted on a motor-driven actuator mechanism which, after installation on the test vehicle and calibration, was capable of being remotely rotated circumferentially over slightly more than 180° to within $\pm 1^{\circ}$ accuracy. This actuator mechanism is indicated in Figure 6 and shown in the photographs presented as Figures 7 and 8. The angular location of the rotating hot-film probe was measured by a potentiometer. The second X-probe was mounted on a fixed retainer on the shroud wall (Figure 8). The hot-film probe retainer and the circumferential actuator system could be incorporated into the inlet outer wall at any desired angular orientation. During the test program, however, the stationary probe was used as a reference and located at $\theta = 150^{\circ}$, forward-looking-aft (FLA), near the bottom of the inlet (see Figure 6). The rotating hot-film probe was movable with respect to the reference probe from $\theta = 82.5^{\circ}$ to 262.5° FLA or, in some cases, from 112.5° to 292.5° FLA. The stationary and the rotating probes were positioned at 6.9 cm (2.7 in.) and 11.4 cm (4.5 in), respectively, upstream of the rotor face. Both probes were indexed manually to various radial immersions in 0.635 cm (0.25 in) steps. This radial indexing could be done only while the vehicle was sitting at idle speed or shut down.

TEST PROCEDURE

Three chamber configurations were tested. These can be described briefly as follows:

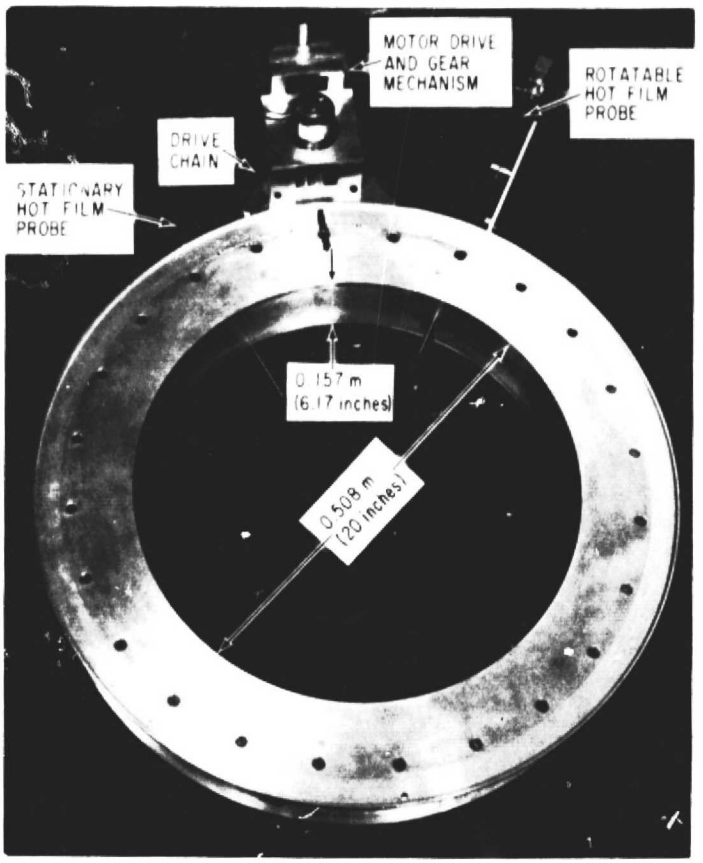


Figure 7. Instrumentation Probe Support and Circumferential Actuator System

Figure 8. Instrumentation Probe Support and Circumferential Actuator System Installed on Test Vehicle

a. Rotor 11 was first tested in the Aero/Acoustic Laboratory in what is referred to as the baseline configuration. All walls, floor, and ceiling of the anechoic chamber were aspirating and the standard hardwall inlet installed (Figure 6). This configuration was tested at the beginning and near the end of the test program.

b. In order to investigate the effect of an incoming ground vortex on the inlet noise of the fan stage, two configurations were tested with a 2.44 m by 2.44 m (8 ft x 8 ft) simulated horizontal ground plane situated beneath the fan inlet (see Figures 9 and 10). The air inflow manifolding to the anechoic chamber floor was blocked during the testing of these configurations. It was found that an auxiliary blower providing a crosswind was not necessary to trigger the ground vortex. The condition for the generation and ingestion of the strongest ground vortices was determined to be with the ground plane situated as close as possible to the inlet bellmouth. This corresponded to Z/D = 0.9, where Z = height of the inlet centerline above the ground plane, and D = inlet diameter. A schematic diagram of this test configuration is shown in Figure 9 and a photograph in Figure 10. The fan was also tested with the minimum Z/D ratio and, hence, the strongest vortex that might be encountered in normal aircraft engine operation. An A300B Airbus with a CF6-50C engine was geometrically simulated with respect to the ground plane. With the aircraft at rest, the engine inlet centerline is Z = 1.16D above the ground. Therefore, for the 0.504 m (20 in.) diameter inlet being tested, the simulated ground plane was situated 0.59 m (23.2 in.) below the fan centerline. This situation also is indicated schematically in Figure 9.

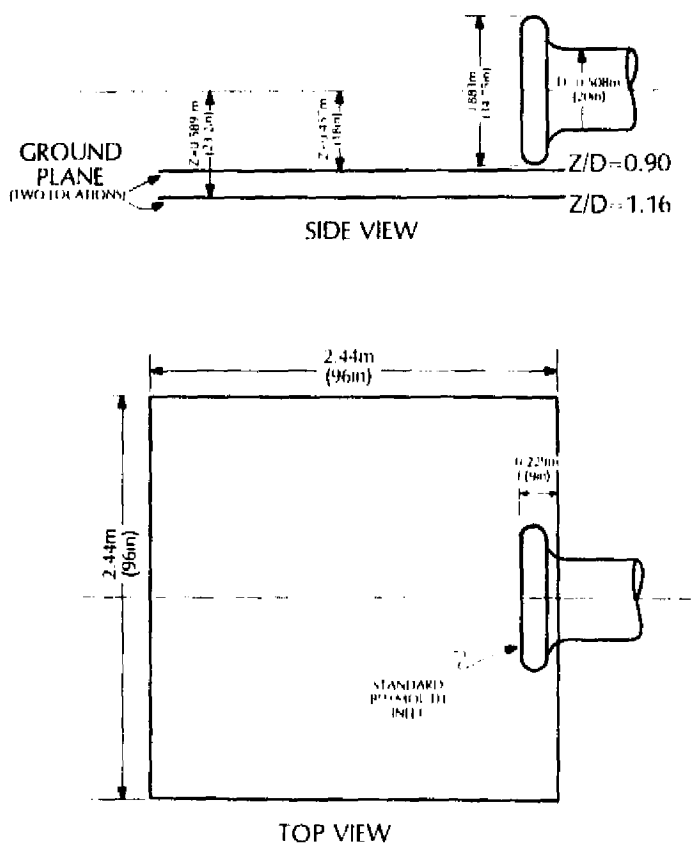


Figure 9. Schematic of Simulated Ground Plane Locations

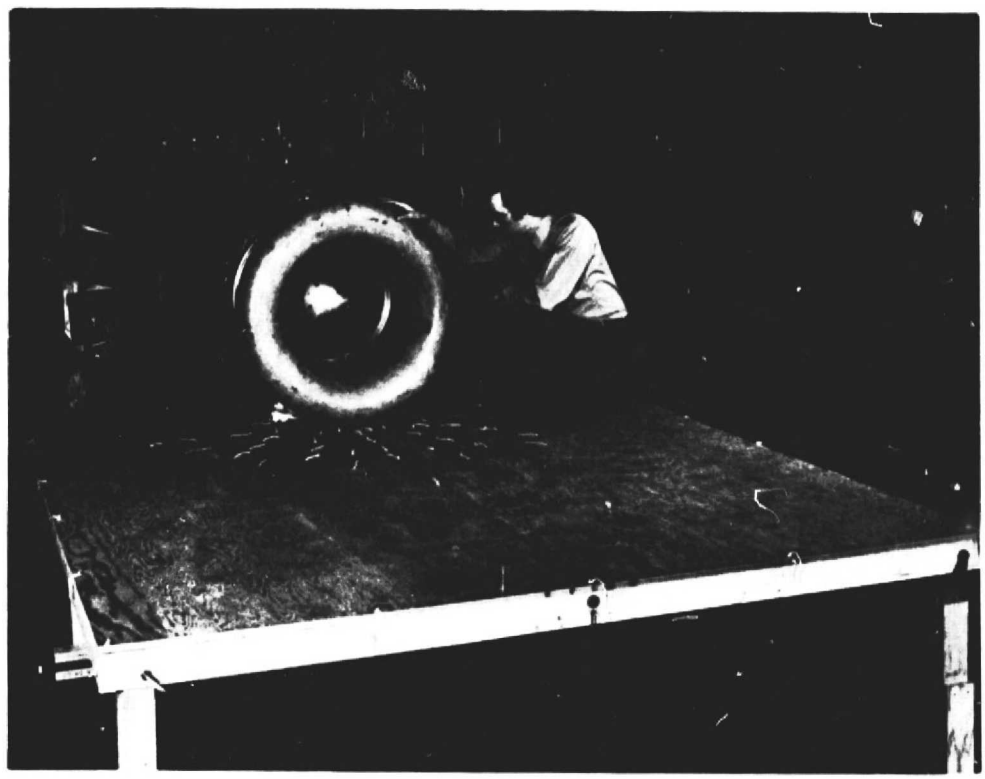


Figure 10. Simulated Ground Plane Installed in Anechoic Chamber for Z/D = 0.9 Configuration

c. Finally, Rotor 11 was tested with the anechoic chamber modified so that flow was admitted only through the doors leading from the filter house (see Figure 3). All manifolding to the floor, ceiling, and walls was blocked. It was expected that with this method of airflow entrance into the anechoic chamber, the axial scale of the flow turbulence structure into the fan would increase.

Aerodynamic measurements were taken prior to measuring other test data. The conditions for these tests are shown in the fan performance map presented as Figure 5. Each of the configurations described above was tested at the wide-open (DV = 0) discharge valve throttle setting (see Figure 5). A test point was reached by adjusting the fan speed to achieve the correct operating point on the fan performance map. The proper physical fan speed was determined as a function of ambient temperature to assure that each test point was at the appropriate corrected fan speed.

Hot-film data were measured at two fan speeds: 69% and 86% corrected speeds. The lower speed (subsonic tip speed, U_T = 293 m/sec [962 ft/sec]) is typical of approach conditions; the higher speed (supersonic tip speed, U_T = 365 m/sec [1199 ft/sec]) is typical of takeoff conditions for current CTOL engines. Hot-film data were recorded for post-test analyses (auto- and/or cross-correlations) only where deemed necessary. During hot-film measurements, the stability of test conditions and instrumentation drift were checked at several repeat points at different times.

For each hot-film test, preliminary on-line circumferential mappings of mean velocity and turbulence intensity in the inlet ahead of the rotor were obtained at several radial positions between the shroud wall and the centerbody (stationary and movable probes at the same radius). Based on the results of these preliminary axial and transverse mean flow and turbulence level measurements, two radial immersions were selected -- 12.7 cm (0.5 in.), and 3.81 cm (1.5 in.) — at which to record hot-film measurements for each test condition on magnetic tape for off-line data analyses. These immersions were characteristic of boundary-layer and free-steam flow, respectively.

Acoustic test points included 54, 69, 86, 90, and 100% corrected speeds. The three lowest speeds were selected so that the corresponding blade passing frequencies would lie near the centers of the 6300, 8000, and 10,000 Hz 1/3-octave bands, respectively, for operating conditions in the -5 to 30°C (23 to 86°F) ambient temperature range, which was encountered during the test period. Far-field acoustic data repeat points were taken at 69% and 86%, and the data were found to be very repeatable. All acoustic data to be presented for 69% and 86%, therefore, will represent the average of two readings for each configuration. No inlet probes were installed during measurement of any far-field acoustic data.

In addition to the above aerodynamic and acoustic measurements, some flow visualization, using freely moving tufts, was used to determine the general character of the inlet flow and, in particular, the existence and character of any ground vortices or other flow disturbances in the neighborhood of the fan inlet. These were videotaped for post-test comparisons and analyses.

DATA RECORDING AND REDUCTION

Fan operation was stabilized to steady state before initiating any data recording. After stabilization, the following operational parameters were logged:

- Inlet Configuration
- Barometric Pressure
- Run Number/Reading Number
- Date/Time
- Chamber Pressure and Temperature
- Rotor Speed (rpm)
- Discharge Valve Position
- Shaft, Gear, and Casing Vibrations
- Bearing Temperature

Basic pressure data were individually sampled through use of a 48 channel Scanivalve system. Temperature data were sampled directly through a Hewlett-Packard (HP) crossbar scanner and digital voltmeter.

The hot-film probes were calibrated prior to the start of the test series, prior to the start of each new configuration, and whenever a change in a probe characteristic was noticed. A schematic of the hot-film anemometer arrangement, its data acquisition and reduction systems, is shown in Figure 11. The signals from an X-probe, A and B, were linearized via a dual channel TSI model 1054 anemometer, then input to a TSI model 1063

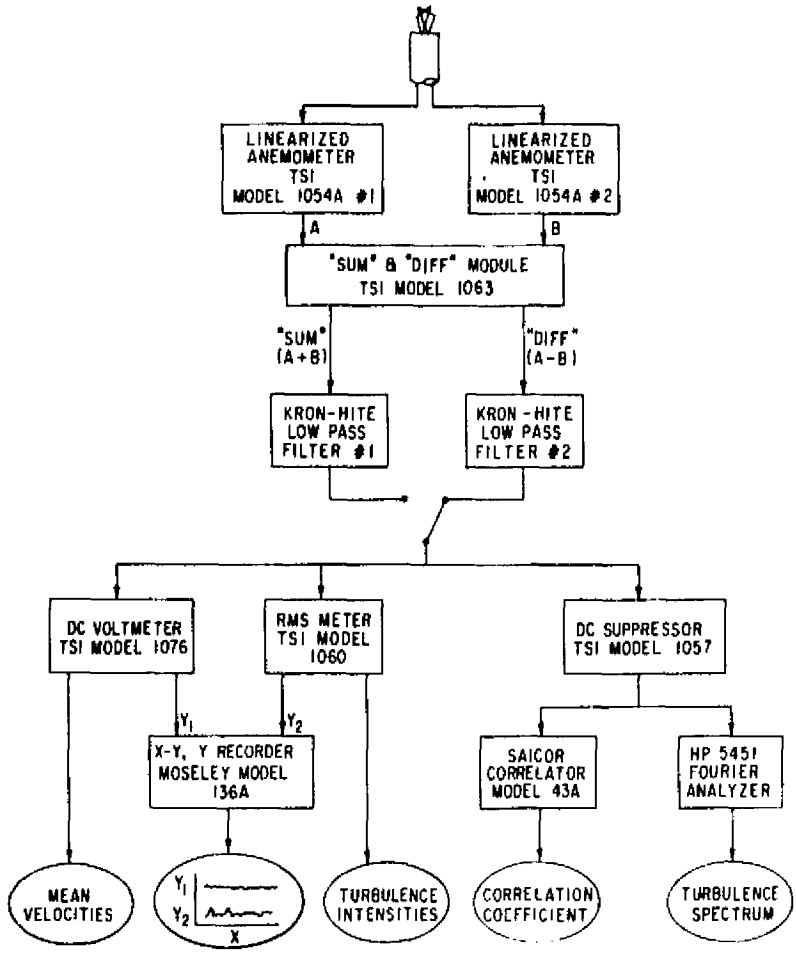
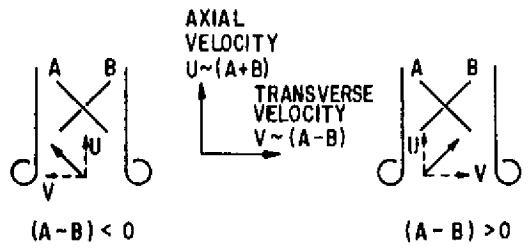


Figure 11. Block Diagram of Hot-Film Measurement System for Stationary or Movable Probe

sum-difference module. The sum (A+B) and the difference (A-B) outputs from the sum-difference module represented respectively the axial (U) and the circumferential (V) velocity components of the flow. The interpretation of the circumferential velocity direction from the (A-B) measurement is shown in Figure 12 (a). The vortex patterns indicated in Figure 12 (b) will be explained later. Calibrations of the X-probes up to 150 m/sec (500 ft/sec) with a standard ASME nozzle flow were performed on each hot-film individually, followed by the sum-difference module outputs. The hot-film signals were analyzed on-line for system check and preliminary observations and reduced off-line for extensive analyses.

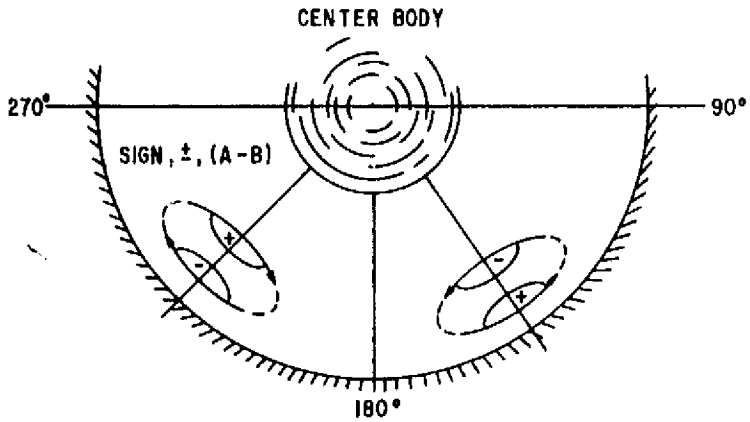
The mean axial velocities from both X-probes were much higher than the circumferential velocities during inlet turbulence measurements. Therefore, a dc suppression arrangement was made with a pair of Tektronix AM2 differential amplifiers to reduce the dc level of these axial velocity measurements. The dc suppression system was designed to preserve the low frequency signals in the hot-film measurements as opposed to a regular ac coupled system. The dc suppressed axial and the circumferential velocity components, measured by the fixed and rotating X-probes, were recorded on magnetic tape for off-line data reduction. A "no flow" and a one-volt calibration signal for each

probe were recorded on each reel of instrumentation tape containing hot-film data. At each recorded hot-film data point, A + B (axial) and A - B (circumferential) dc-suppressed rms signals were recorded for both probes simultaneously at 30 in./s for approximately 3-1/2 minutes. The Sangamo Sabre IV model 4918 tape recorder had 20 kHz capability in the FM mode at 30 in./s.



"X"-ARRAY HOT FILM DIRECTIONALITY

(a)



GROUND VORTEX VISUALIZATION VIA
CIRCUMFERENTIAL VELOCITY MEASUREMENTS

(b)

Figure 12. Interpretation of X-Probe Hot-Film Velocity Measurements

Four types of information were obtained from the data reduction system: 1) mean velocities, 2) turbulent velocities, 3) integrated turbulence length scales, and 4) turbulence power spectra. The first two quantities were usually obtained on-line, using dc voltmeters and rms meters. The outputs from the dc voltmeter and rms meter represented the mean and turbulent velocities, respectively. These were plotted on an X-Y,Y plotter (Mosely model 136A X-Y,Y recorder), with X representing the hot-film circumferential position. A pair of low-pass filters set at 5 kHz cutoff frequency were used at the inputs to the dc voltmeter and rms meter to reduce the noise on the signal. During production of these on-line velocity plots, a time constant of 0.1 second was used on both meters to keep up with the scanning speed of the moving hot-film probe. During off-line analyses, however, a time constant of 10 seconds was used for turbulent velocity measurements.

The integrated turbulence length scales were obtained from the auto- and cross-correlation measurements of the fixed and rotating hot films. The correlation measurements were performed by means of a Saicor model 43A Correlator. The turbulence length scales were obtained on the basis of the usual assumption that the autocorrelation function was an exponential function with respect to delay time. Space-time cross-correlation measurements were performed only on the Z/D = 0.9 ground plane configuration. Turbulence power spectra were measured in the HP5451-A Fourier analyzer. Much attention was given to the signals at low frequencies (below 10 Hz) which were expected to correspond to the inlet disturbances.

An electrostatic calibration of the acoustic data acquisition system was performed prior to starting the test series. In addition, all far-field microphones were calibrated with a piston phone, and the calibrations were recorded on each reel of instrumentation tape containing far-field data. Prior to the test series and whenever an instrument was replaced, microphone serial numbers, amplifier serial numbers, monitor scope numbers, and their respective tape tracks were recorded.

The acoustic data from the far-field microphones were recorded simultaneously at 60 in./s for one minute at each data point. The 28 track Sangamo recorder used (Sabre IV model 4918) had a 40 kHz capability in the FM mode at 60 in./s.

Forward radiated SPL and PWL noise spectra were obtained. Basic microphone acoustic output was 1/3-octave bands from 100 Hz to 80 kHz. The 1/3-octave analyzer was a General Radio model 1927 real-time analyzer whose digital output was put on a magnetic tape by the HP 2100 computer system. A final step was scaling the data to standard day conditions (59^{o}F, 70% relative humidity), using the CRD 635 computer.

Section 4

TEST RESULTS

HOT FILM RESULTS

An unfortunate but significant aspect of the test setup was discovered during the hot-film mappings of the baseline configuration. Each of the types of inlet disturbances specifically tested (ground vortices and large-scale turbulence), in addition to wakes shed from test-stand supports (Figure 2), is more likely to be present at an outdoor test facility than in a carefully designed indoor test chamber. However, the baseline experiments carried out during this program demonstrated that such anechoic chambers have yet another source of inlet distortions. These disturbances can be classified as those arising from the "upstream" flow along the exterior cowl as ambient air is drawn into the inlet from all directions (Figure 13). Such disturbances may be caused by instrumentation leads, probe supports and actuators, and flanges. These types of distortions may also occur in outdoor test facilities; but during indoor anechoic chamber tests, in the absence of those disturbances occurring outdoors, these distortions can become important to inlet noise generation.

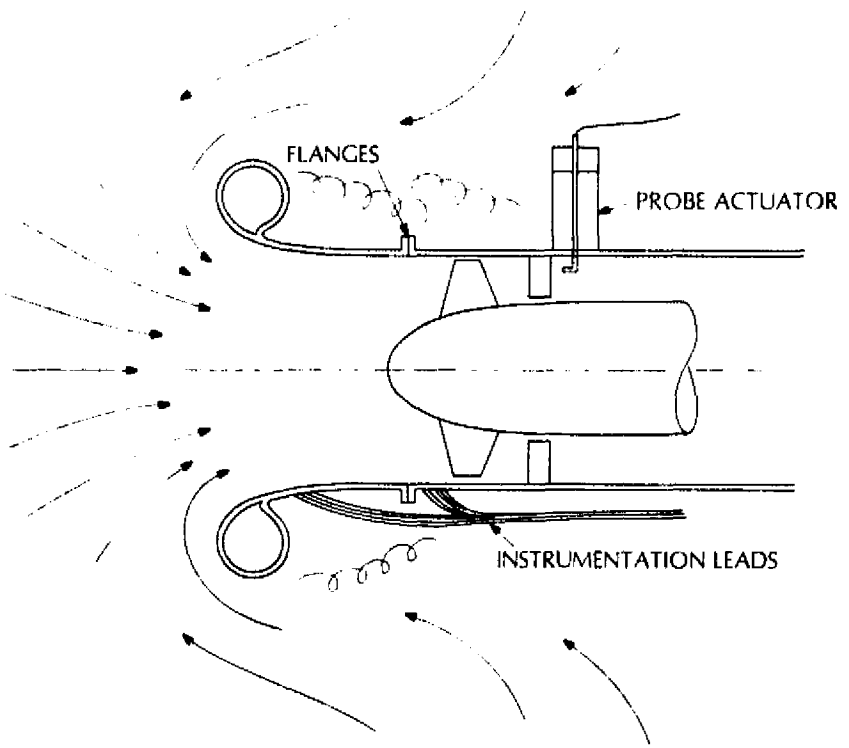


Figure 13. Inlet Disturbances Arising Along the Exterior Cowl as Ambient Air is Drawn into the Inlet

Evidence of such exterior-cowl-related disturbances are shown in Figure 14, where inlet hot-film mappings are shown for the baseline chamber arrangement. The 180° location shown in all such figures as Figure 14 was the bottom center of the inlet. Distortions originating from the circumferential actuator motor support (seen at the top of the photograph in Figure 7, but located near the bottom of the inlet during testing) and

a V-retainer flange coupling bolt are indicated in Figure 14 (a) and (b). A conventional radial actuator was added between these disturbance sources during a second circumferential mapping; the influence of its wake is clearly seen in the data shown in Figure 14(b). (A pair of these radial actuators is seen at 90° and 180° in Figure 4, a photograph taken during an earlier program.) Freely moving tufts were attached to each of these protuberances, and there was clear visual evidence of wakes being shed by them as flow passed upstream over them toward the inlet.

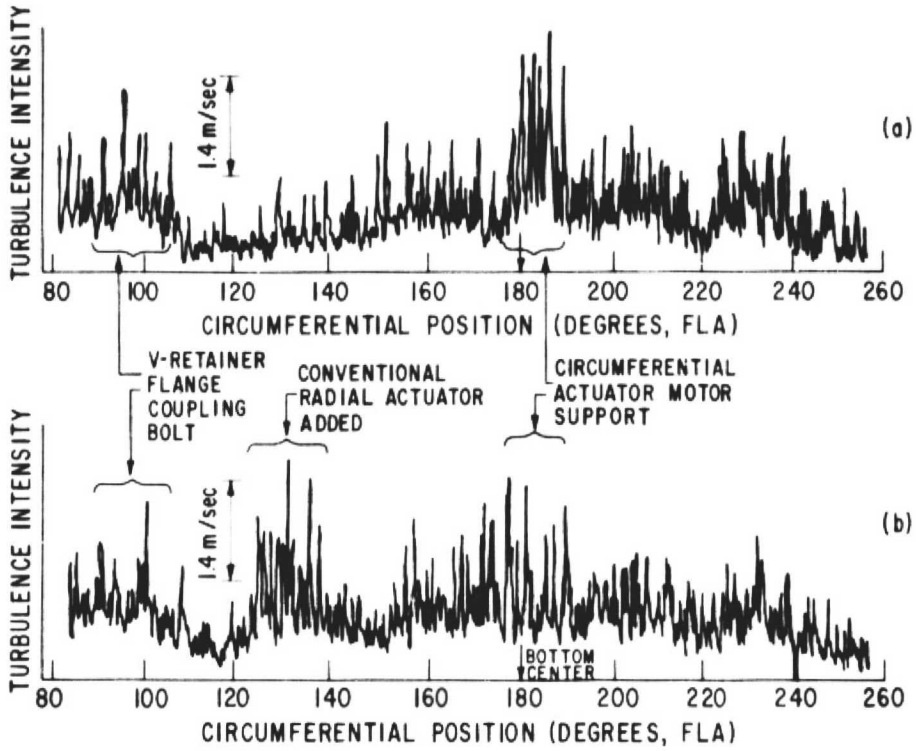


Figure 14. Baseline Configuration Circumferential Hot-Film Mappings Showing Wakes Shed by Several Disturbances on Exterior Cowl (corrected speed, $N/\sqrt{\theta}$ =100%; mean velocity, $\bar{U}$ =145 m/sec; hot-film probe immersion = 1.27 cm)

One obvious ramification of these results is that, whenever an actuator is used for a hot-film probe during a static test, care must be exercised to assure that the inlet flow fluctuations being measured are not directly attributable to the actuator, its support, or even the probe stem itself. Although these fixtures are outside the inlet, they are directly in line with the upstream flow along the exterior cowl, which passes into the inlet and over the sensor.

Figure 15 (a) and (b) show scanning plots of the on-line circumferential mean and turbulent velocities, respectively, at the Z/D = 0.9 ground plane location for 69% speed. The abscissa is the angular location, θ, of the rotating hot-film probe. Velocity traces were obtained at various radial immersions from the outer wall of the inlet section. The existence of a ground vortex pair can be seen clearly in these two sets of velocity and turbulence traces. First, the mean circumferential velocities at the 0.635 cm (0.25 in.), 1.27 cm (0.50 in.), and 2.54 cm (1.0 in.) immersions were found positive on one side of the bottom center (180°) and negative on the other. Based on the direction interpretation

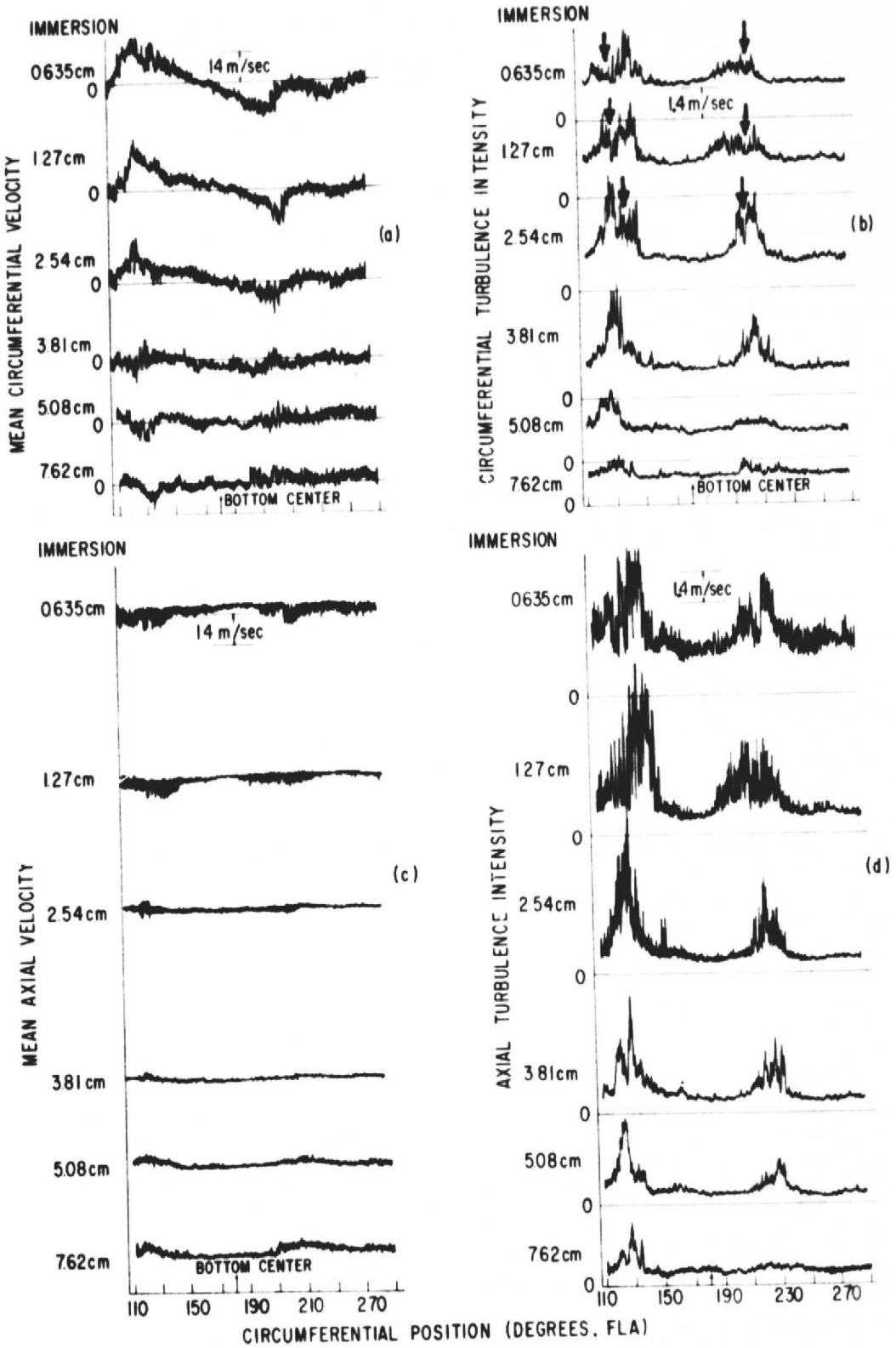


Figure 15. On-Line Inlet Mean and Turbulent Velocity Profiles with Ground Plane at Z/D = 0.9; 69% Speed

shown in Figure 12(a), the flow moved in opposite directions on either side of the bottom center. As the hot-film immersion increased from 2.54 cm (1.0 in.), toward inlet centerline, to 7.62 cm (3.0 in.), the transverse velocities reversed their directions. A sketch of this measured velocity orientation observation is shown in Figure 12 (b).

A pair of ground vortices easily fits into the explanation of this observation. Further evidence for the ground vortices can be deduced from the turbulent velocity plots shown in Figure 15(b). High turbulence is observed where the vortices are identified from the mean velocity plots. Slight dips in the turbulent velocity measurements near the middle of the high turbulence areas are indications of the existence of the vortex centers (0.635, 1.27, and 2.54 cm [0.25, 0.50, and 1.0 in.] immersions); these are indicated by the arrows in Figure 15(b). One vortex was centered near 135°, FLA, while the other occurred near 225°. The swirl direction of the vortices deduced from the hot-film velocity scans agreed with the observation of tufts on the ground plane. At distances greater than 3.81 cm (1.5 in) from the outer wall, the turbulence and the mean circumferential velocity gradually diminish. The edge of the ground vortices appears to be situated near the 7.62 cm (3 in) immersion location.

The vortices can also be seen from the corresponding axial velocity and turbulence plots shown in Figures 15(c) and (d). At the vortex, the mean axial velocity always showed a decrease except near the vortex center. This can be attributed to the momentum transfer from the axial direction to the radial and circumferential direction due to swirling motion of the vortices. The turbulence maxima of the axial velocity were found at locations similar to those obtained in the corresponding circumferential velocity plots. Again, there were definite minima within the high turbulence regions which were indications of the vortex centers. The amplitudes of the maxima of the axial and circumferential velocity turbulence were found peaked at about 2.54 cm (1 in.) and 3.81 cm (1.5 in.) immersions. The amplitudes of the axial turbulent velocity maxima were about twice those in the circumferential direction. However, the axial velocity measured by (A+B) of the X-probe also contains the radial velocity.

For the inlet flow configuration, both mean and turbulent velocities in the radial direction should be of the same magnitude as those in the circumferential direction. Thus, the mean axial velocity was close to the measured mean sum (A+B) from the X-probe because the mean radial velocity was much smaller than the axial velocity. For the turbulence measurement, the radial turbulent velocity was the same magnitude as the axial turbulent velocity. When the radial component was separated from the sum (A+B) turbulence measurement, the amplitudes of the turbulent velocity maxima were found about the same in axial, radial, and circumferential directions.

At 86% speed and Z/D = 0.9, a similar ground vortex pair was observed from on-line hot-film measurements and tuft motion. However, the hot-film measurements at this supersonic tip speed condition contained significant multiple pure tone noise (MPTs). The MPTs were so dominant in the measurements that these data points were not analyzed beyond on-line velocity scanning.

On-line velocity plots were also made at 69% speed when the ground plane was moved to the Z/D = 1.16 position. Results were obtained similar to those shown in Figures 15(a) through (d). The turbulence level was found to be weaker than those obtained for the Z/D = 0.9 case. A single vortex was found in some cases, because the weaker of the ground vortex pair either disappeared or became too weak to be observed.

Flow velocities for the baseline anechoic chamber condition (no ground plane and with porous walls, etc) are shown in Figure 16. The mean circumferential and turbulent velocities were found to be smaller than those obtained with the ground plane condition. Although no ground vortex pattern was found, a high turbulence region around the bottom center (180°) was obtained at the 1.27 cm (0.5 in.) immersion. This is attributed to a wake shed from the hot-film actuator, which was discussed earlier.

Similar velocity scannings were performed for the nonporous anechoic chamber condition. As discussed in Section 3, under normal test conditions airflow is manifolded to and aspirated through the walls, floor, and ceiling, thus providing a porous-box arrangement. For this test, however, all manifolding to the floor, ceiling, and walls was blocked and the doors leading from the filter house (which are normally closed) were opened to provide the only means of airflow into the chamber (see Figure 3).

The turbulence level during the nonporous chamber tests was found to be higher than that observed for the porous chamber condition. Composite plots of the turbulent velocities at Z/D = 1.16 ground plane, porous chamber and nonporous chamber conditions, are shown in Figure 17. Data presented in these plots were obtained off-line from the recorded hot-film signals, with the rms meter at a time constant of 10 seconds. A single vortex was found between $\theta = 100^{\circ}$ and 140° in the ground plane case. Near 180°, however, high turbulence regions were found in all three cases. These again are attributed to the wake shed from the actuator. The turbulent velocities for the nonporous chamber condition were about 50 to 100% higher than those for the porous chamber condition. Instead of having coherent turbulent regions, as was the case for the vortex in the ground plane condition, the high turbulence was present around the whole inlet.

Integrated turbulence scales were obtained from the autocorrelation measurement of the hot-film signals. Figure 18 shows these computer turbulence scales for the porous and the nonporous chamber conditions at 69% speed and for two immersions (1.27 cm [0.5 in.] and 3.81 cm [1.5 in.]). The length scale in the axial direction was found to be about 10 times longer than that in the circumferential direction. This was an expected observation, as discussed in the Introduction (Section 2), because flow is accelerated into the inlet, causing turbulence disturbances to be stretched in the axial direction. In the case of ground vortices, they theoretically should have infinite length scale along the flow axial direction. The turbulence length scale for the nonporous chamber condition is about 2 to 4 times longer than that at the porous chamber condition. This confirms that the nonporous chamber introduces large-scale turbulence at the inlet compared with that of the porous chamber.

Circumferential velocity space-time cross-correlations were performed between the stationary and the rotating hot films for the 3.81 cm (1.5 in.) immersion at the Z/D = 0.9 ground plane condition and 69% speed. The reference point was the location of the fixed probe ($\theta = 150^{\circ}$). The cross-correlograms are shown in Figure 19. The angular separation between the rotating and the fixed hot film is indicated as $\Delta\theta$, which ranges from -10° to $+20^{\circ}$ with respect to $\theta = 150^{\circ}$. The transverse turbulence scale was found smaller than the circumferential arc of $\Delta\theta = 30^{\circ}$. Between $\theta = 150^{\circ}$ and 160° the cross-correlation function changed sign, indicating the ground vortex center.

Figure 20 shows typical autopower spectra of a circumferential velocity signal at $\theta = 150^{\circ}$, 3.81 cm (1.5 in) immersion, 69% speed, and nonporous chamber condition. Most energy in the signal was clearly at frequencies less than 1 Hz. This is only a qualitative indication of the distorted inlet turbulence frequency characteristics. Only

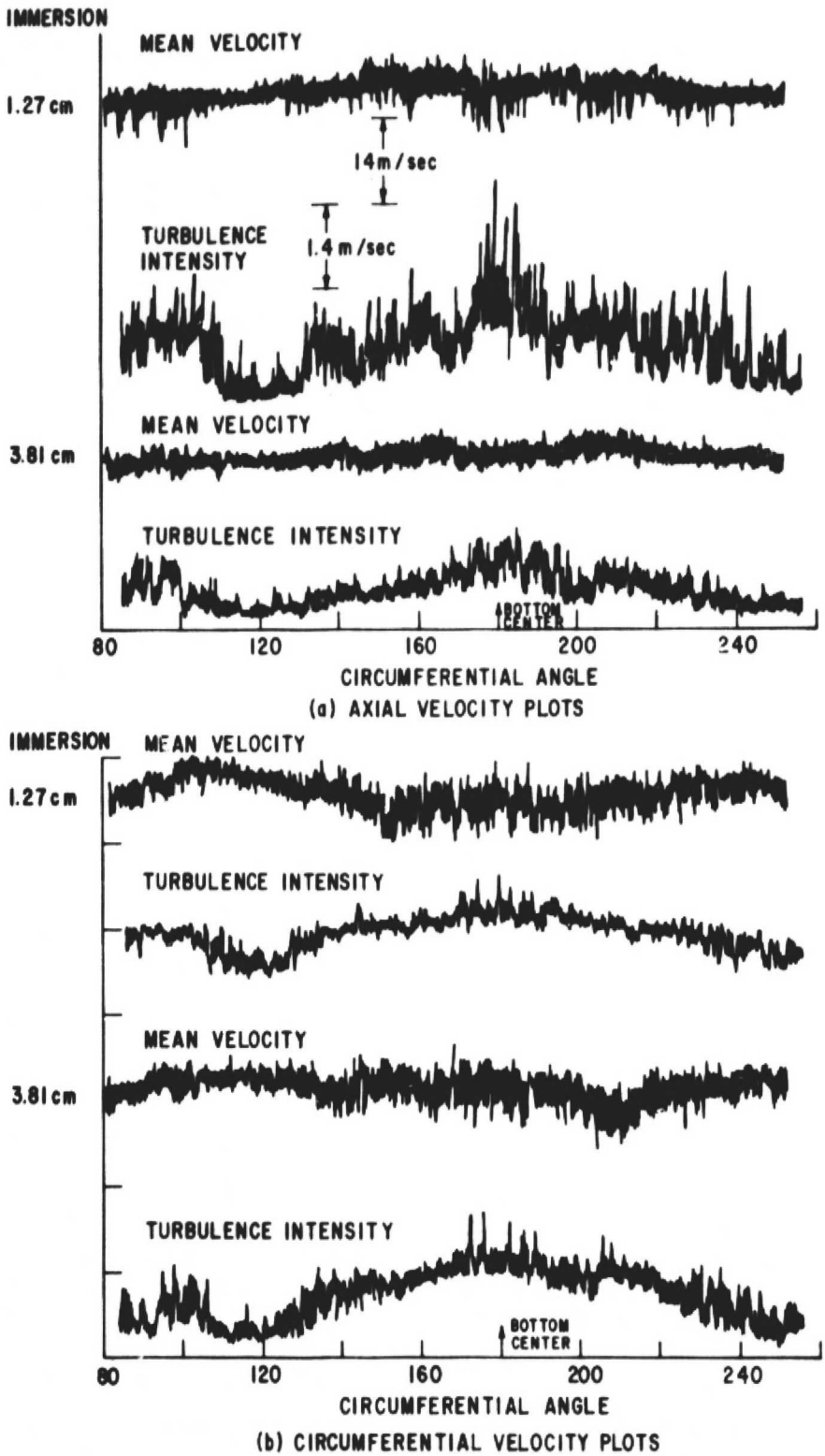


Figure 16. On-Line Inlet Mean and Turbulent Velocity Profiles for the Porous Chamber Configuration (baseline) at 69% Speed

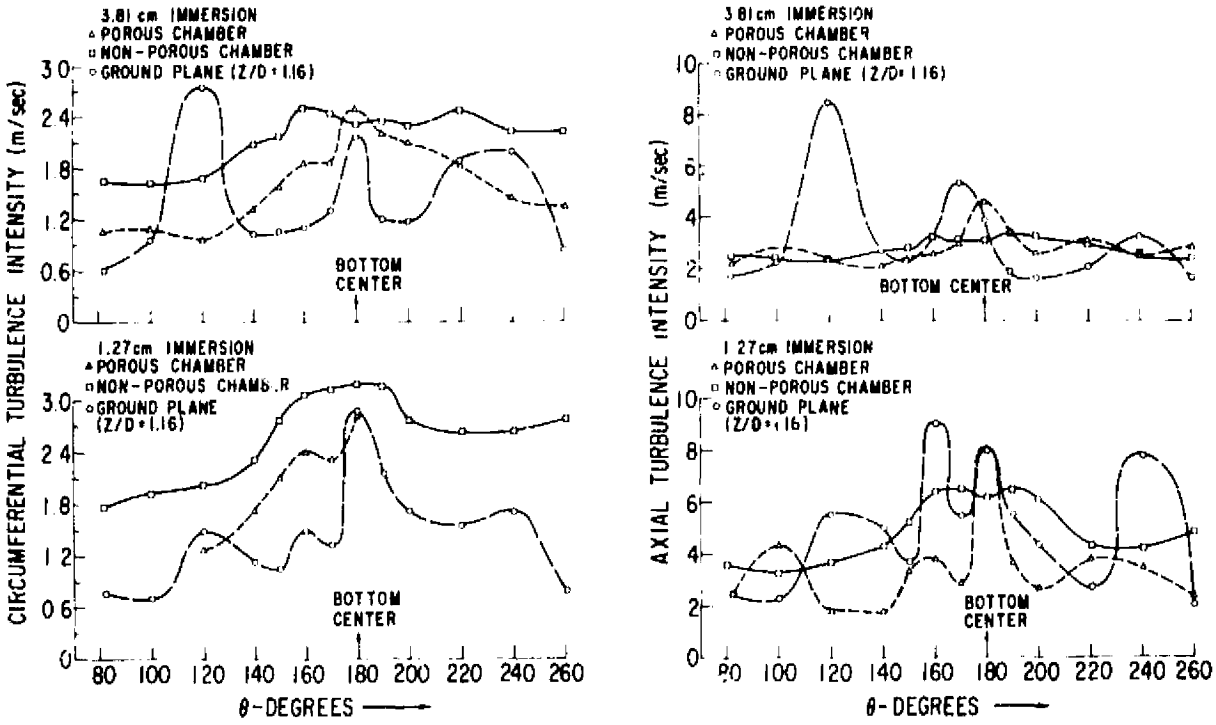


Figure 17. Comparison of Turbulent Velocity Profiles for Ground Plane, Nonporous Chamber and Porous Chamber Configurations at 69% Speed

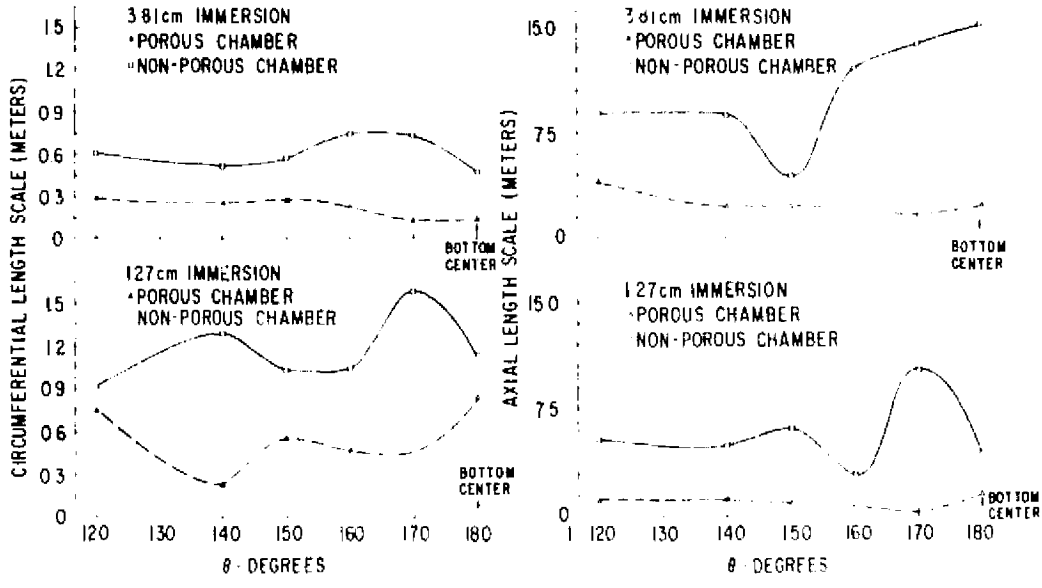


Figure 18. Comparison of Integrated Turbulence Length Scales for the Porous and Nonporous Chamber Configurations at 69% Speed

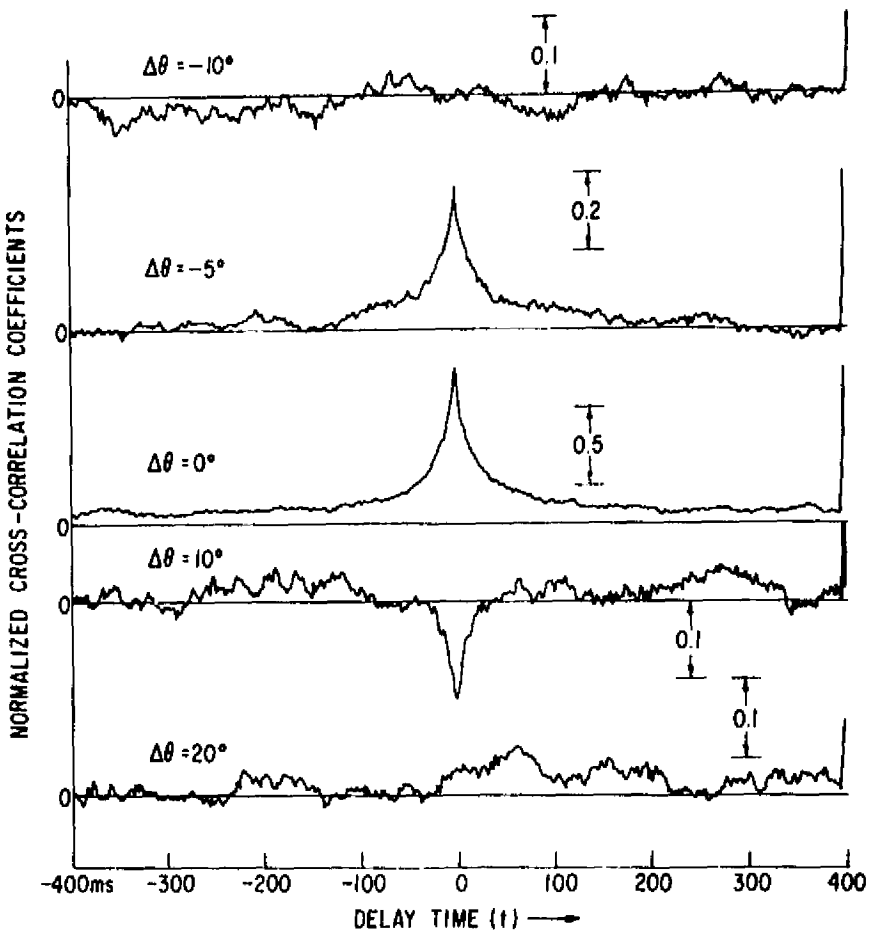


Figure 19. Typical Circumferential Velocity Space-Time Cross-Correlation Measurements with Respect to a Stationary Hot-Film Probe at 150° (3.81 cm immersion; 69% speed; Z/D = 0.9 ground plane configuration)

very limited spectral averages were obtained, because of the long sampling time needed to process the data.

In addition to hot-film measurements, flow characteristics in the vicinity of the inlet were investigated by the placement of freely moving tufts. These tuft movements were videotaped. The results showed, as expected, that there was no ground vortex in the baseline (porous) chamber; however, tufts placed on the sunburst arrangement of foam wedges on the plenum wall behind the inlet (see Figure 4) showed moderate activity. Flow over instrumentation leads and probe actuators on the exterior cowl was also clearly in evidence. With the ground plane at Z/D = 0.9, flow visualization, consisting of an array of tufts on the ground plane in an area beneath the inlet, indicated that a pair of counter-rotating vortices was present (see Figure 8). These vortices were present at all fan speeds, including idle. The direction of the vortex swirl agreed with the hot-film measurements described earlier. In addition, tufts were placed along the periphery of the ground plane to check for wake flow along the edges. Negligible activity was evidenced by these tufts.

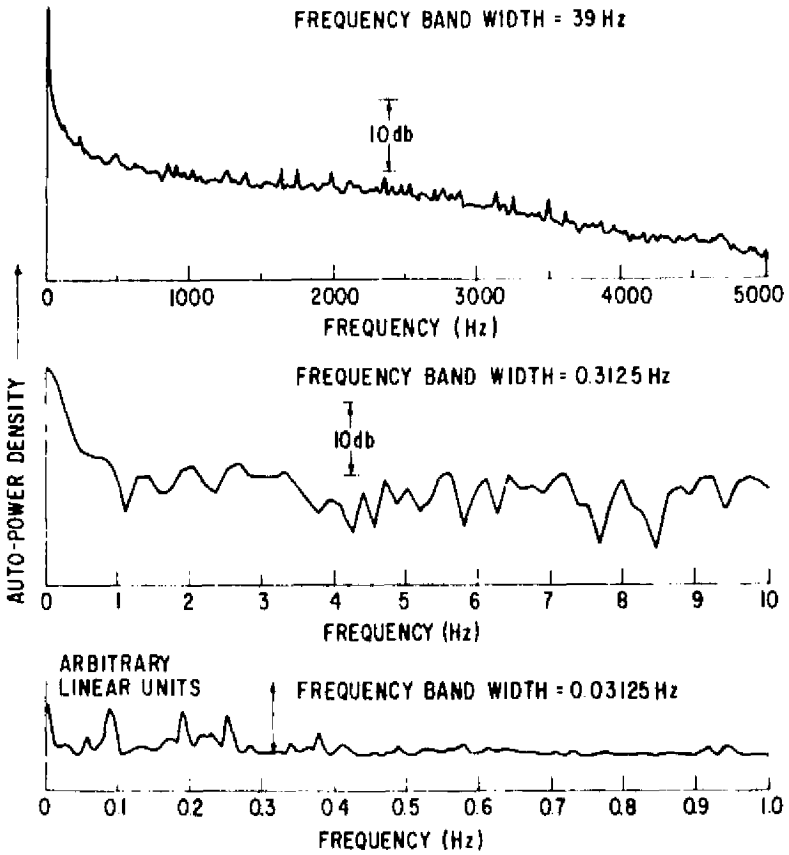


Figure 20. Typical Autopower Spectra of Circumferential Velocity Measurement

ACOUSTIC RESULTS

Far-field acoustic results will be presented for the five speeds tested: 54, 69, 86, 90, and 100%. Rotor 11 is cut-off at the lower two speeds and cut-on at the higher three speeds. Far-field acoustic data repeat points were taken at 69% and 86% and the data were found to be very repeatable. All acoustic data at 69% and 86%, therefore, represent the average of two readings for each configuration. Full information on the 1/3-octave-band acoustic data obtained in this program is given in tabular form in Appendix II. These data include 1/3-octave-band sound-pressure levels (SPL) and calculated overall sound-pressure levels (OASPL), sound-power levels (PWL), and overall sound-power levels (OAPWL).

Analyses of the complete set of the SPLs showed that there was no noticeable evidence of ground plane reflection influencing the measured far-field data. This was investigated further by using a controlled noise source. While the test vehicle was shut down, a whistle was placed in the inlet face at the center of the far-field microphone arc. Acoustic measurements were then taken with the ground plane in its two test locations (Z/D = 0.9, 1.16) and with the ground plane completely removed from the chamber. These data showed no clear evidence of ground reflections.

Further analyses of the far-field acoustic data showed that the presence of the ground plane caused no significant redirection of the blade-passage-frequency (BPF)

tone noise. For example, the BPF 1/3-octave-band SPLs for the Z/D = 0.9 configuration are shown in the directivity plots of Figures 21 to 25. These data generally do indicate a 1 to 2 dB increase in BPF SPL when the ground plane was present. However, on the basis of past experience, these slight increases in SPL, which seem to be the trend here, cannot be considered too significant. In fact, at isolated angles, the SPL level at a particular speed might show a slight decrease. However, if data from only a particular microphone are examined, even a very slight change in directivity might result in misleading interpretations of the data. Therefore, no attempt at firm conclusions is made based on these plots. Further acoustic comparisons made using PWL spectra obtained by integrating the sound level around the microphone arc are discussed in the following paragraphs.

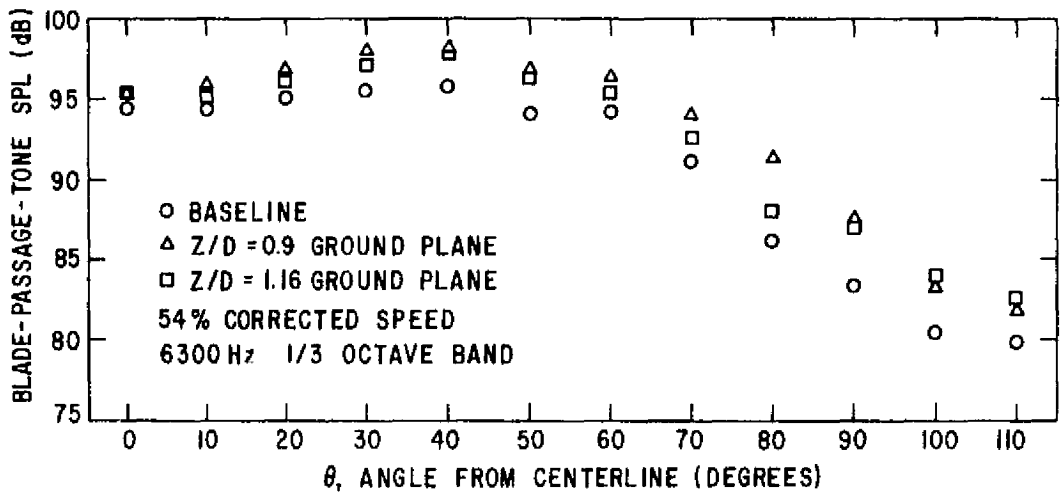


Figure 21. Blade Passing Frequency SPL Directivity; 54% Corrected Speed

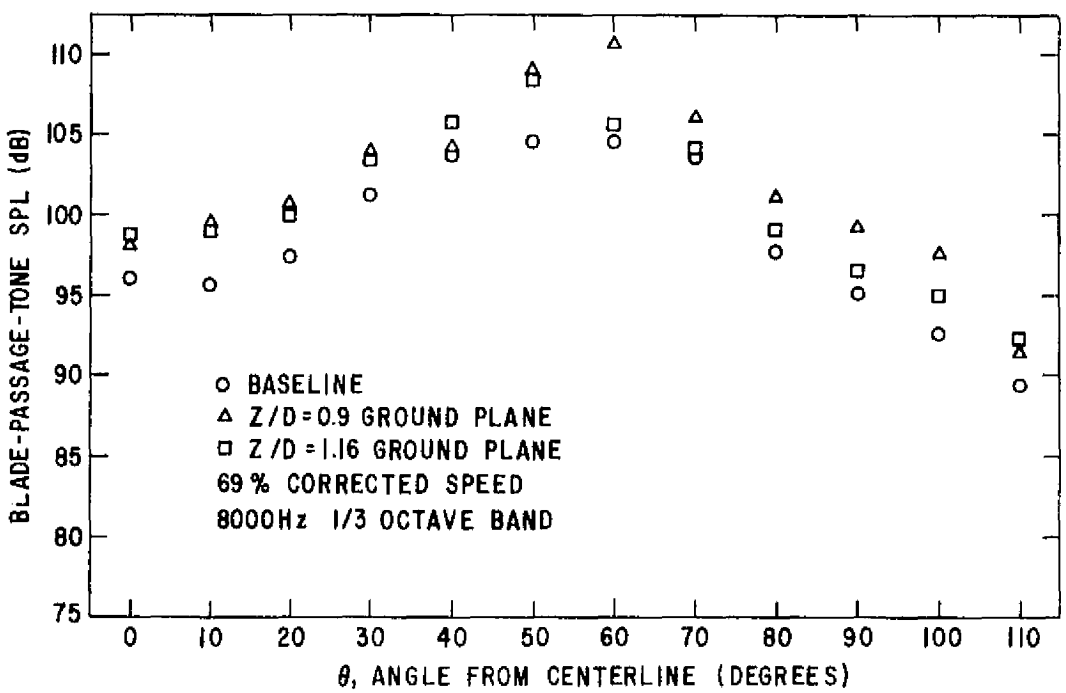


Figure 22. Blade Passing Frequency SPL Directivity; 69% Corrected Speed

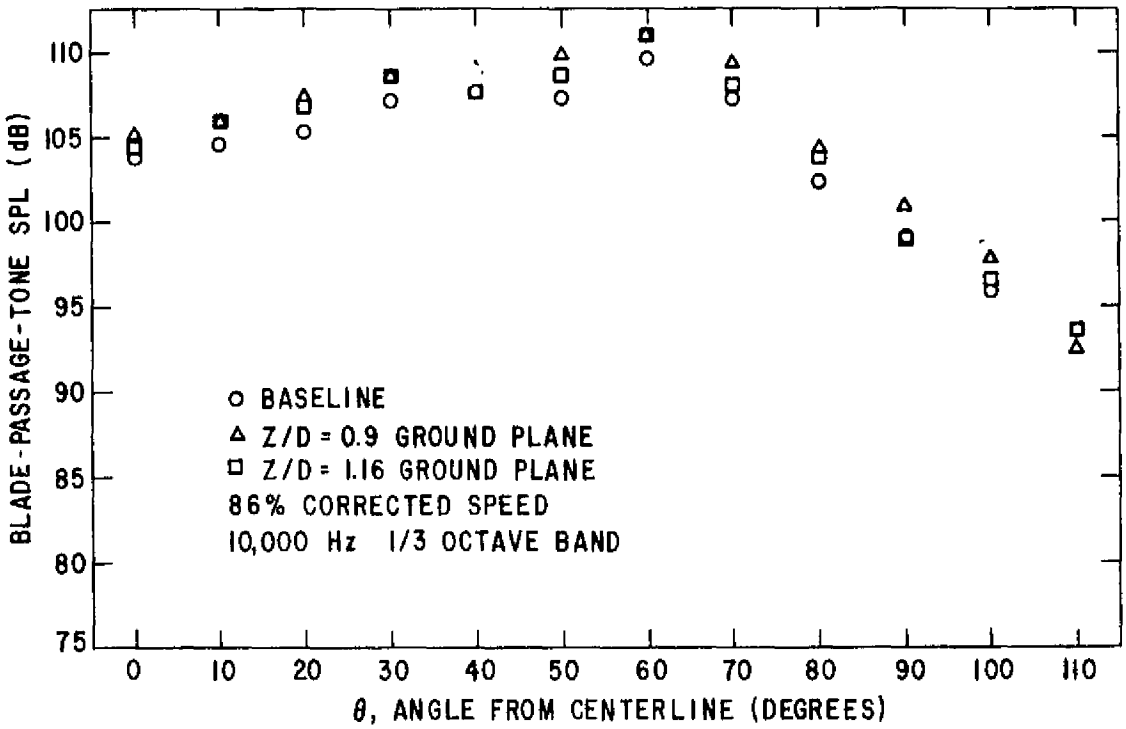


Figure 23. Blade Passing Frequency SPL Directivity; 86% Corrected Speed

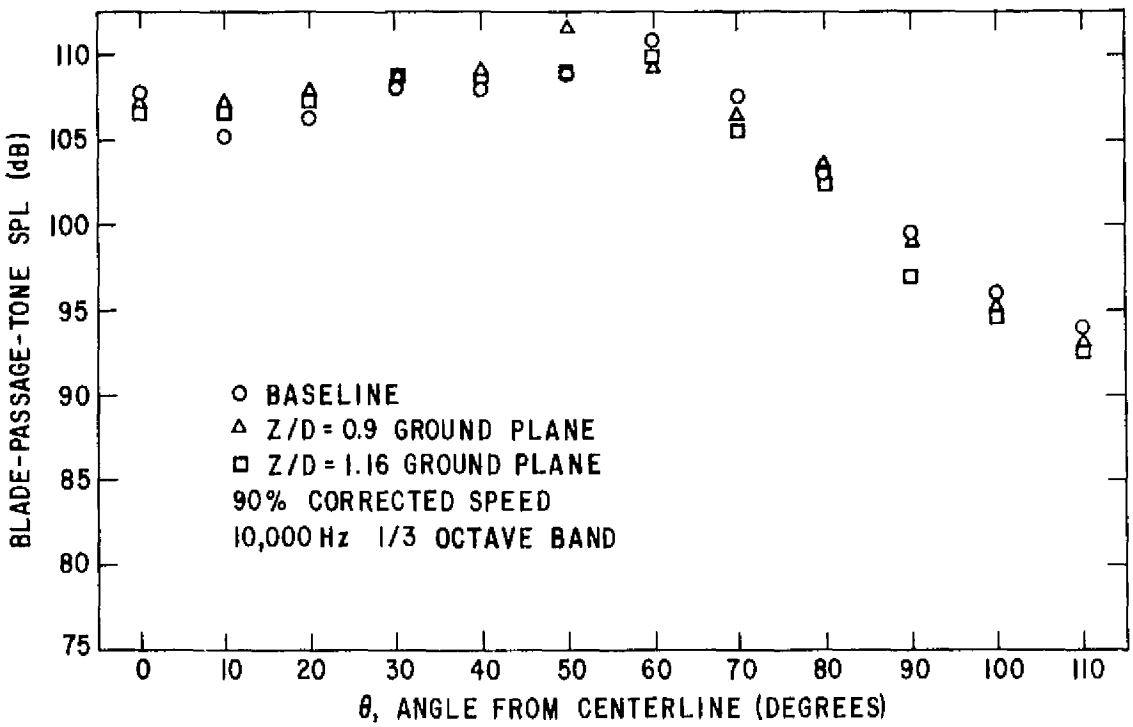


Figure 24. Blade Passing Frequency SPL Directivity; 90% Corrected Speed

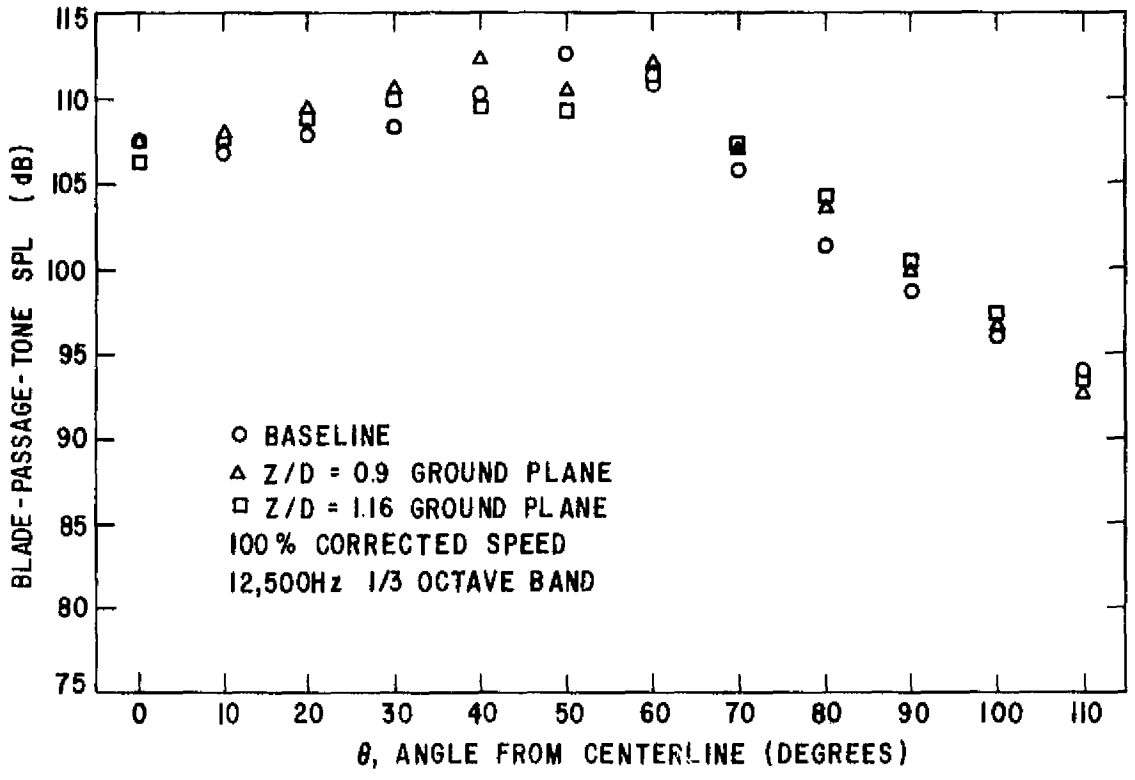


Figure 25. Blade Passing Frequency SPL Directivity; 100% Corrected Speed

Power level spectra for the baseline and the two ground plane configurations (Z/D = 0.9 and Z/D = 1.16) are shown in Figures 26 to 30 for the five speeds tested. The data for these three configurations are barely distinguishable from one another when plotted in this manner, because of the small changes in PWL (< 5 dB) resulting from the presence of the ground vortices. Therefore, in an attempt to see if any trends are present, the data in Figures 26 to 30 are replotted in Figures 31 to 35 on a ΔPWL basis; i.e., subtracting the appropriate baseline PWL spectra from each ground plane configuration PWL spectra. Thus, a positive ΔPWL represents an increase in noise for the ground plane configuration as compared with the baseline. The blade passage tone 1/3-octave band is indicated for each speed.

It is seen in Figures 31 to 35 that both broadband and tone level increases are less for Z/D = 1.16 than for Z/D = 0.9.* This result is not surprising, since the ground vortices were weaker and more unsteady when the ground plane was further from the inlet.

*Although the PWL spectra in Figures 26 to 30 are very close together, it can be seen that the acoustic levels in the broadband region below blade passage frequency, as well as the BPF tone level for the Z/D = 1.16 ground plane configuration, generally fall between the baseline and the Z/D = 0.9 case.

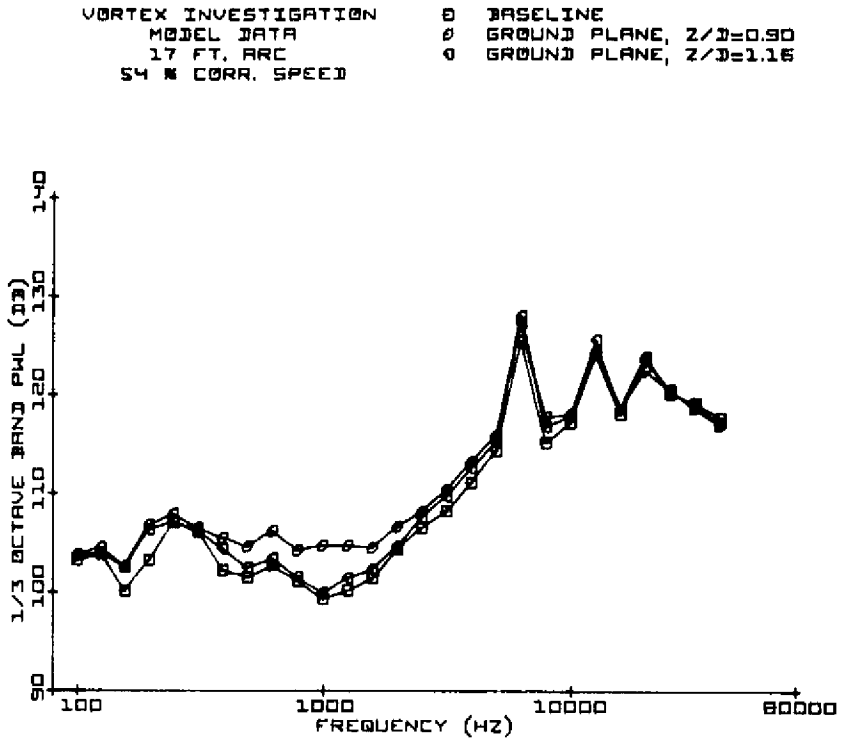


Figure 26. Baseline and Ground Plane PWL Spectra for 54% Corrected Speed

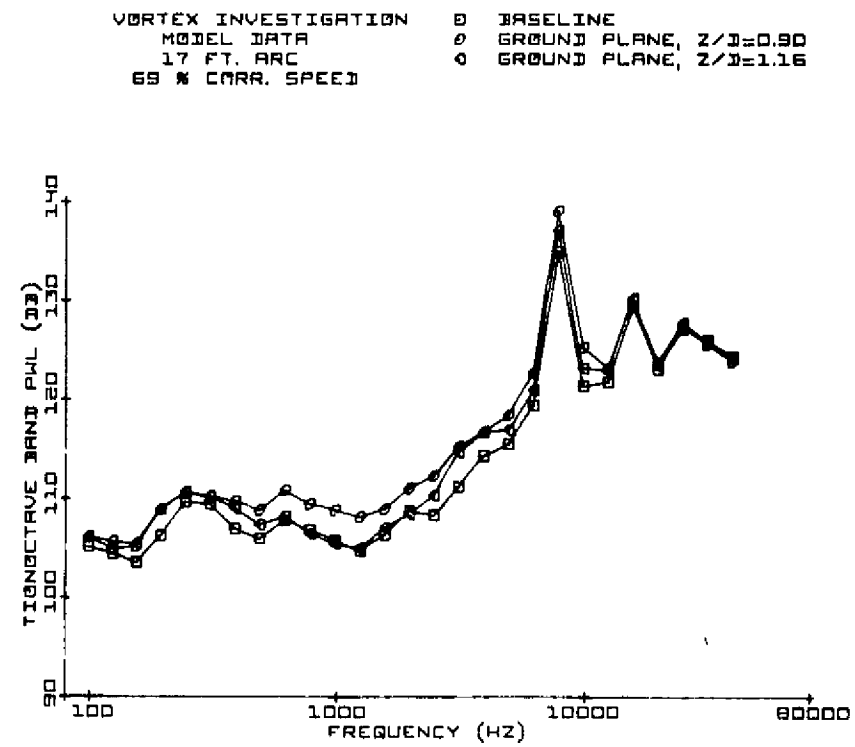


Figure 27. Baseline and Ground Plane PWL Spectra for 69% Corrected Speed

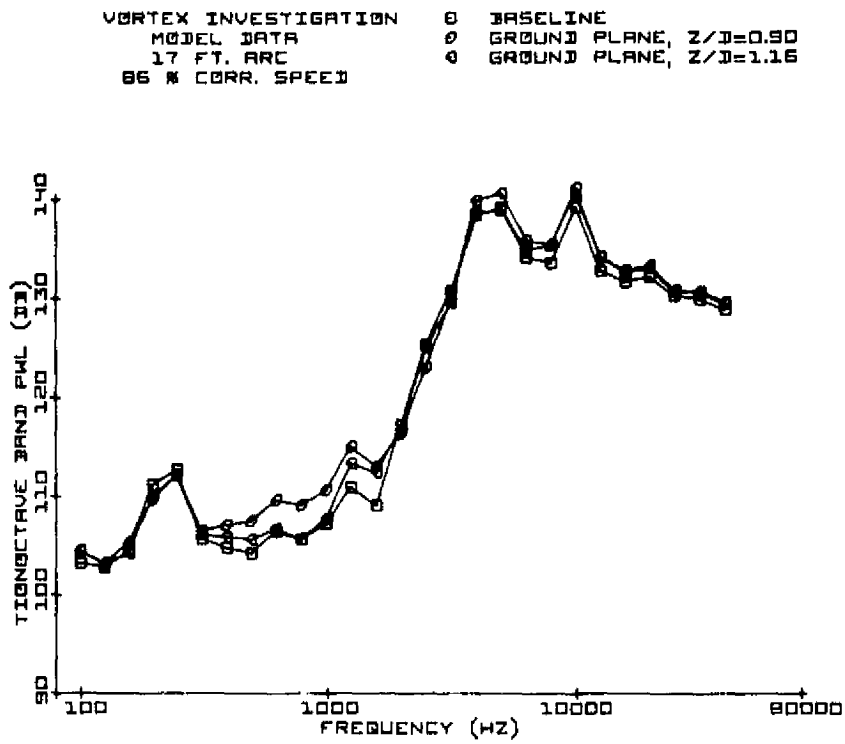


Figure 28. Baseline and Ground Plane PWL Spectra for 86% Corrected Speed

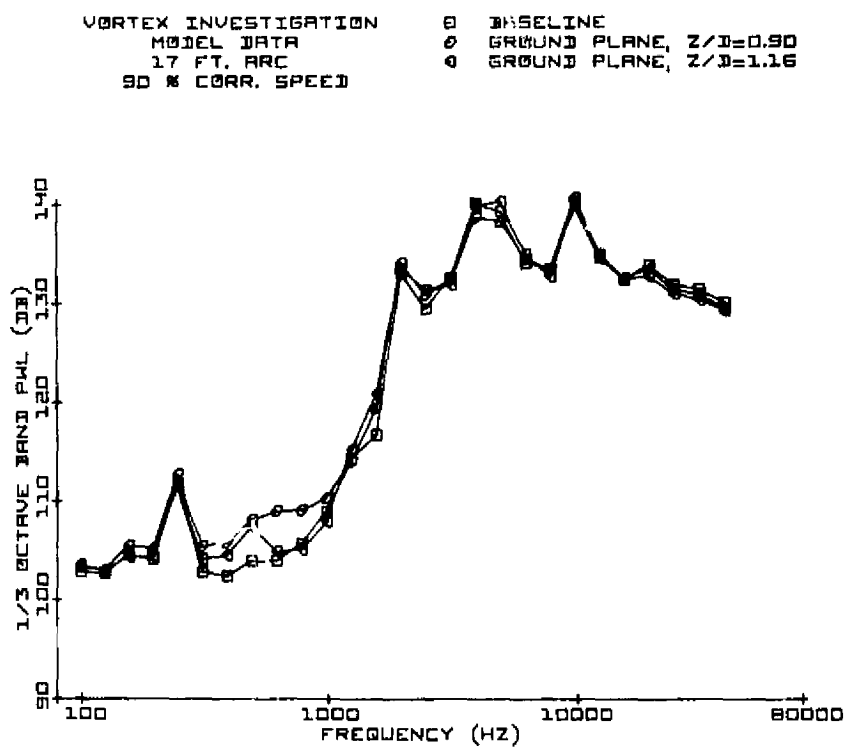


Figure 29. Baseline and Ground Plane PWL Spectra for 90% Corrected Speed

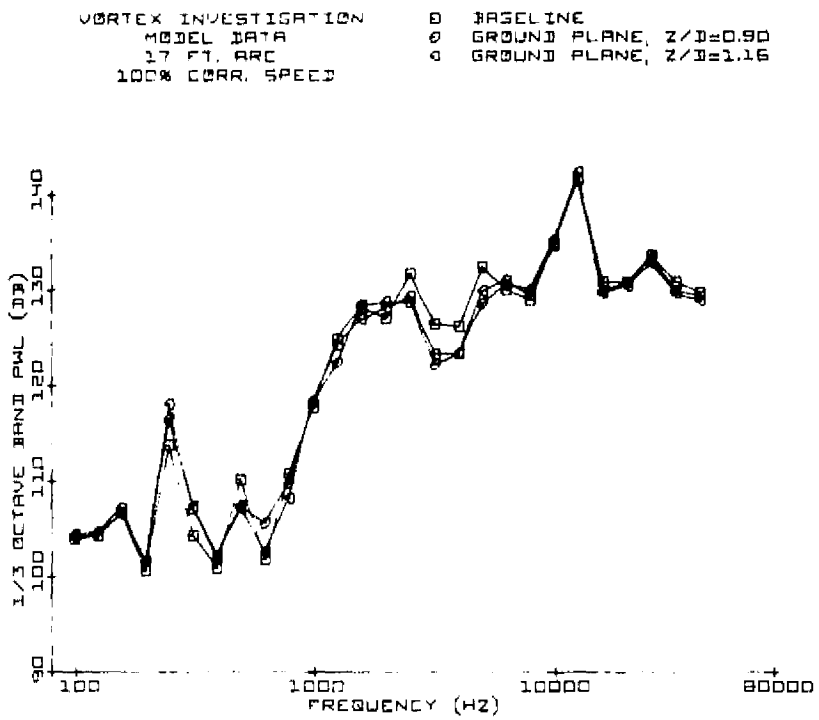


Figure 30. Baseline and Ground Plane PWL Spectra for 100% Corrected Speed

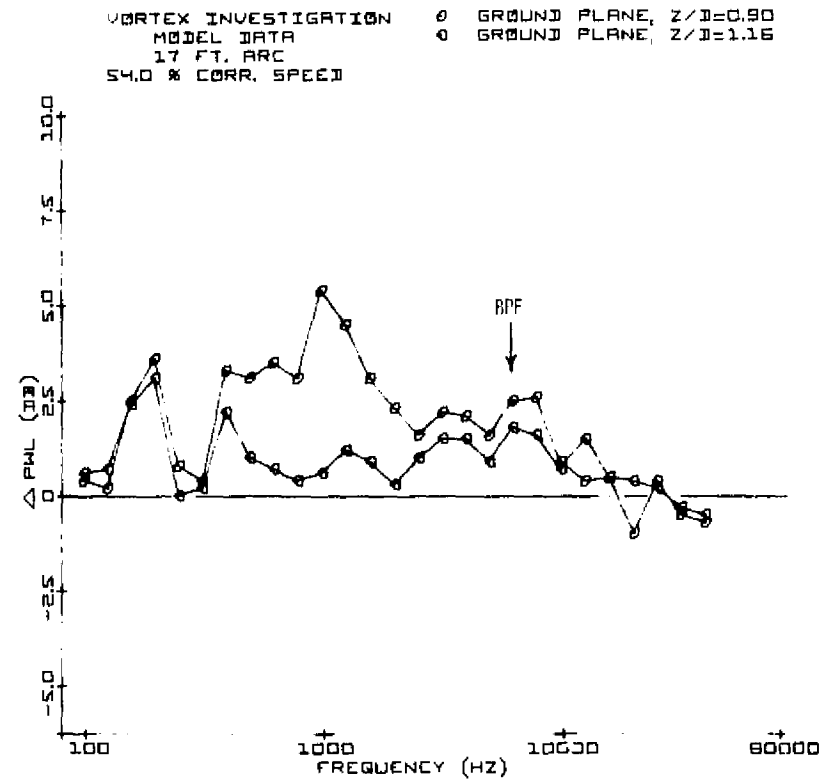


Figure 31. 54% Speed PWL Increase Due to Ground Plane

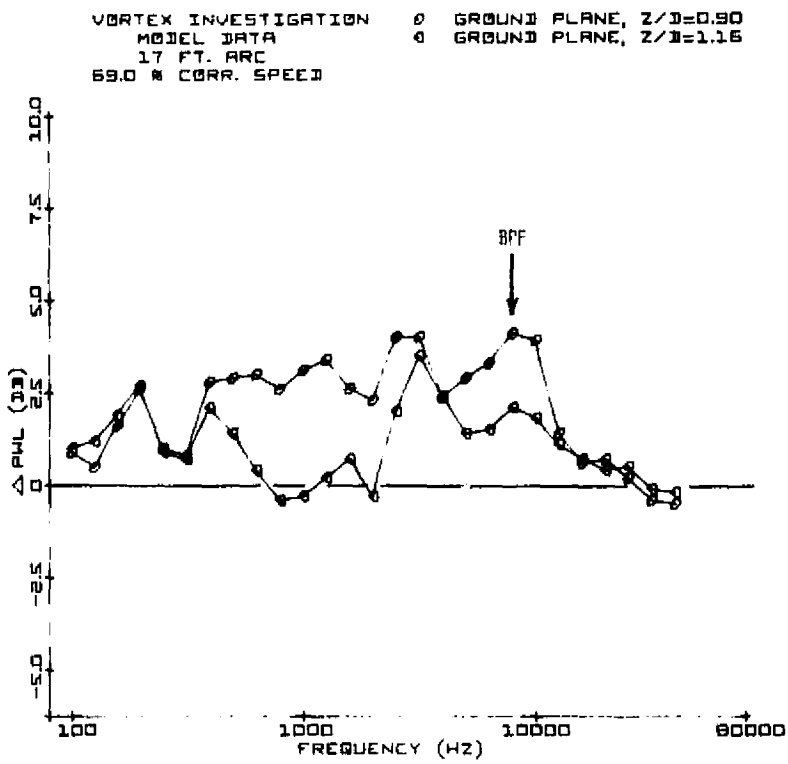


Figure 32. 69% Speed PWL Increase Due to Ground Plane

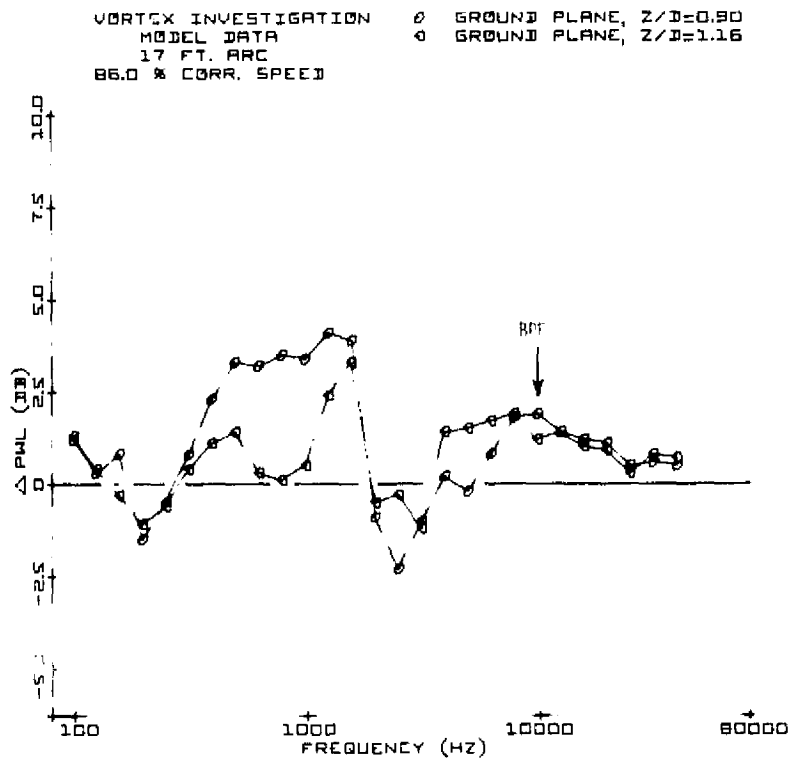


Figure 33. 86% Speed PWL Increase Due to Ground Plane

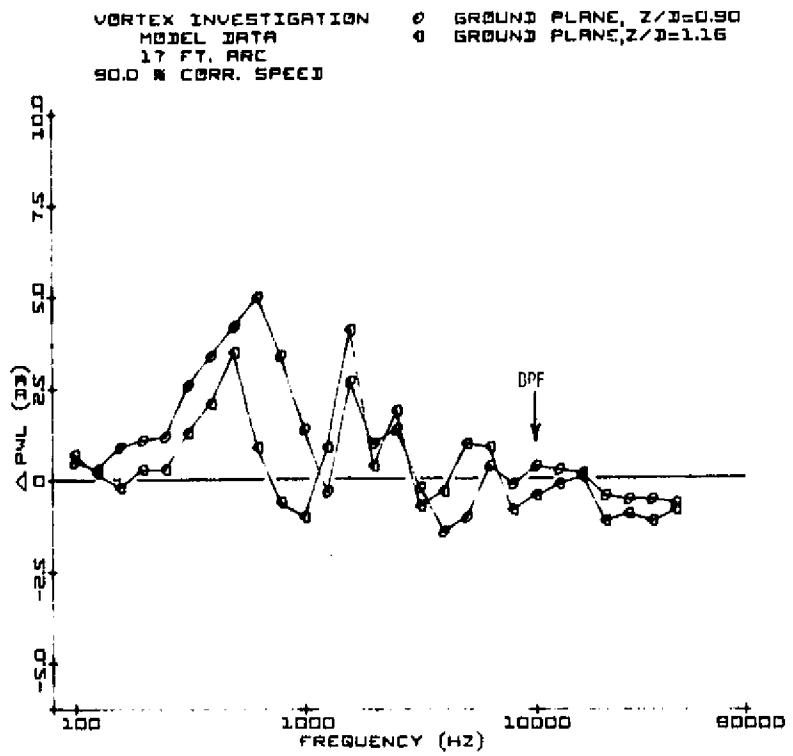


Figure 34. 90% Speed PWL Increase Due to Ground Plane

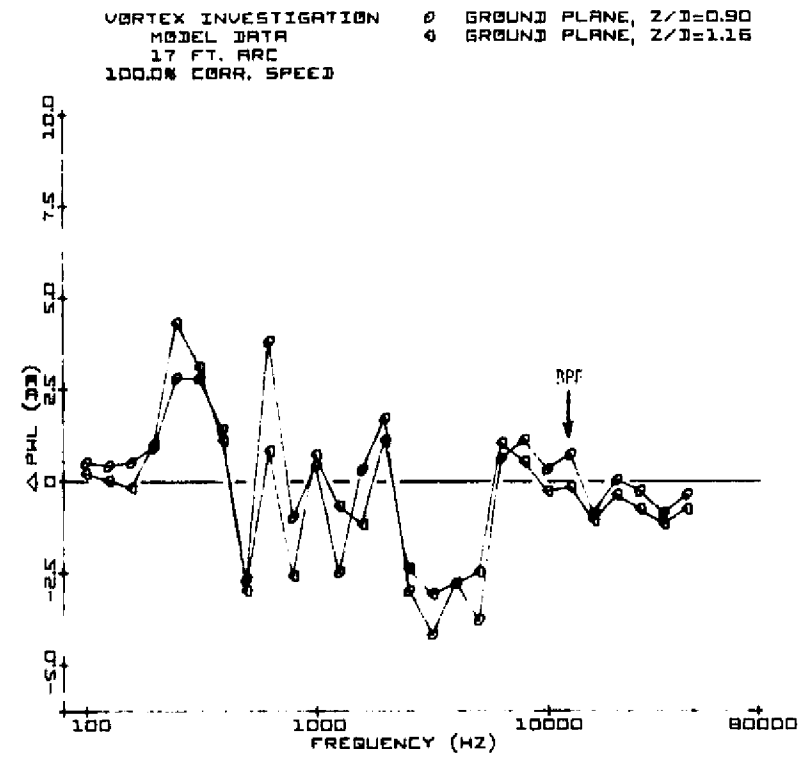


Figure 35. 100% Speed PWL Increase Due to Ground Plane

The ΔPWLs at blade passing frequency are plotted versus corrected fan speed in Figure 36. Of particular interest is the similar trend shown for the two ground plane conditions tested. The increases in blade-passage-frequency PWL were greater for the subsonic relative tip speed (cut-off) data points (54% and 69%) than for the supersonic relative tip speeds (cut-on). In fact, for the Z/D = 1.16 ground plane condition, the results at 90% and 100% fan speeds indicated that the BPF PWLs were slightly lower than for the baseline. The lesser increases in BPF tone levels for supersonic speeds was an expected result. At supersonic relative tip speeds, the noise generation mechanisms are dominated by multiple pure tones (buzz-saw noise) which, as a noise source, do not rely heavily on inlet disturbances. Results reported in References 2, 3, and 14 also indicated that inlet-distortion/rotor interaction noise was most noticeable at subsonic relative tip speeds. It was also pointed out in the Introduction (Section 2) that the difference between measured static and actual flight data is generally greater at approach (subsonic tip speed) than during takeoff (supersonic tip speed) operating conditions.

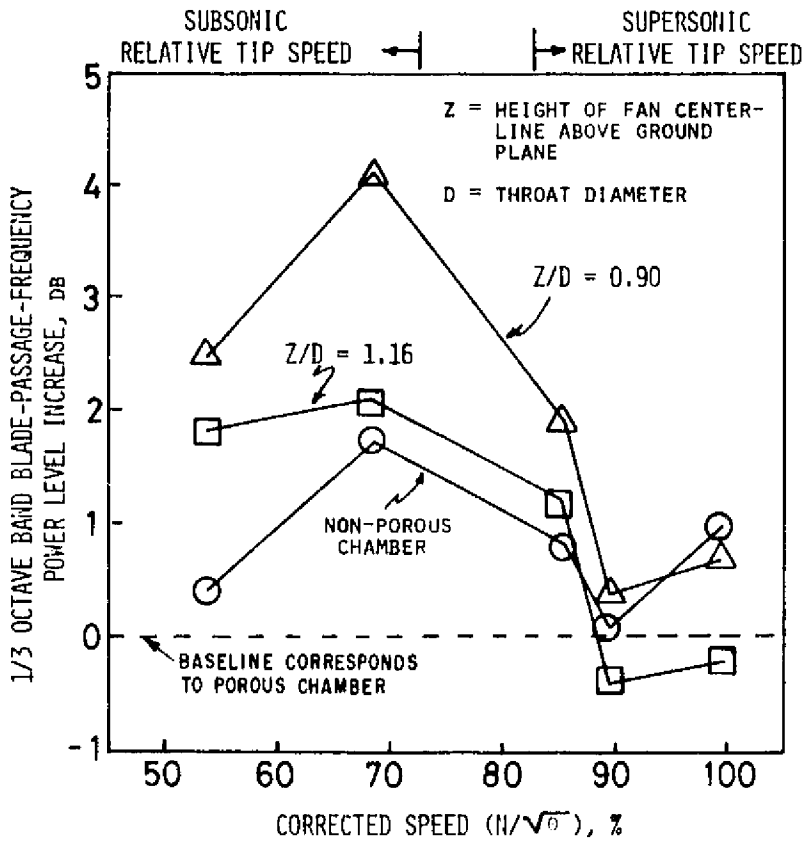


Figure 36. Blade-Passage-Tone PWL Increase for Ground Plane and Nonporous Chamber Configurations Compared with Baseline

Far-field acoustic data were also measured while the anechoic chamber was modified into the nonporous test cell configuration, in order to assess the possible influence such a chamber inflow arrangement might have on the noise generated by the fan. The measured sound power level increase at blade passage frequency for the nonporous test chamber arrangement, compared with the porous (baseline) chamber, is

summarized as a function of fan speed in Figure 36. These BPF tone levels are again presented on a ΔPWL basis such that a positive ΔPWL indicates that the nonporous configuration was noisier than the porous (baseline) chamber. The subsonic/supersonic tip speed regimes were as evident here as they were for the ground plane results. However, the levels of tone increase for the nonporous chamber are generally less than for either of the two ground vortex situations.

Section 5

DISCUSSION OF RESULTS

The fan inlet airflow always has a turbulence field consisting of many eddy cells whose associated characteristic time, τ , can be found by autocorrelating a hot-film signal. This characteristic time is then related to the length scale of the inflow turbulence by $L = \bar{U}\tau$, where $\bar{U}$ is the mean axial flow velocity. As the turbulence cell passes through the rotor, each blade which interacts with it will experience a lift fluctuation. This mechanism can therefore cause noise to be generated at blade passage frequency and higher harmonics. The time it takes the fan to rotate one pitch width is equal to the reciprocal of the blade passage frequency. Therefore, the number of times the characteristic turbulence cell is interacted with as it passes through the rotor is $n = \tau \times (BPF)$. A more thorough analytical investigation of this noise generating mechanism has been presented in References 13 and 15 through 19. The authors only wish to remind the reader here that the number of times the characteristic turbulence cell is "chopped" as it passes through the rotor is a qualitative measure of the efficiency of this noise source mechanism.

The results presented in Figure 18 indicated that, in the nonporous chamber configuration, the characteristic turbulence cell interacted with the rotor considerably more times (factor of 2 to 4) during its passage through the fan than it did for the porous chamber. Apparently the aspirating walls sufficiently reduced the length scale of turbulence to effect the BPF PWL changes indicated in Figure 36 for subsonic tip speeds. This physical description of the noise mechanism also helps explain why both ground planes tested exhibited greater BPF PWL increases than did the nonporous chamber. When a ground vortex is present in the inlet, $\tau \to \infty$ and the inlet-distortion/rotor interaction noise source mechanism is expected to be most efficient.

It was pointed out earlier that inlet disturbances whose origins were flow over protuberances on the exterior cowl were also present. It is not possible with the data on hand to assess the acoustic impact of these disturbances. However, it is speculated that the influence was substantial, because these disturbances were nearly as high in amplitude as, and steadier than, the distortions generated intentionally. So, in reality, the ΔPWLs presented earlier (Figure 36) were based on a contaminated baseline rather than a baseline with a "pure" undistorted inlet flow. The actual acoustic impact of large-scale inlet turbulence and ground vortices is probably greater than that measured under this effort.

An attempt will be made in the anechoic chamber which was used during this test program to remove the exterior-cowl source of inflow disturbance. The method to be investigated incorporates a partially porous, flared inlet (see Figure 37). The purpose of such an inlet is not only to enclose some of the possible sources of flow contamination but also to remove by suction that portion of the airflow which is most likely to be nonuniform. The cone-shaped inlet fairing will extend from the bellmouth back toward the chamber wall, following the expected streamlines as closely as possible. The fairing will cover the flanges, probe mechanisms, etc., that have been shown to be sources of inflow distortions. In addition, the perforated section will be included on the fairing near the bellmouth so that suction can be applied to the reverse flow to extract any disturbed flow that might still exist.

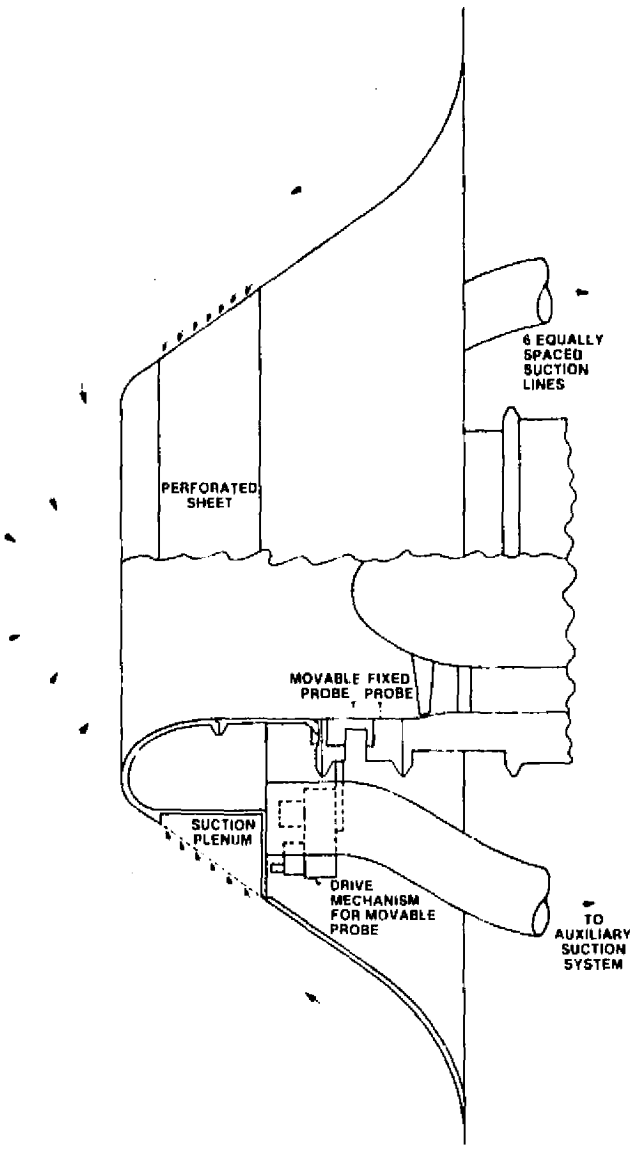


Figure 37. Conceptual Sketch of Flared Inlet with Exterior Cowl Boundary Layer Suction

Section 6

CONCLUSIONS

The hot-film measurements using a rotatable X-probe have successfully provided information on fan inlet disturbances at various inlet conditions. A strong ground vortex pair was detected when a simulated ground plane was located at Z/D = 0.9; the strength of the vortices decreased as the ground plane was moved away from the inlet to Z/D = 1.76. Although no particular coherent ground vortex type structure was found for the nonporous chamber condition, the turbulence length scale for this condition was measured as 2 to 4 times that for the porous chamber (baseline) condition. This large-scale turbulence was dominated by frequencies less than 1 Hz.

The acoustic results can be separated into subsonic relative tip speed and supersonic relative tip speed regimes, indicating that different noise-generating mechanisms are active in the two regions. At subsonic speeds, modest increases in blade-passage-tone levels (up to 4 dB) were measured while ground vortices or large-scale turbulence were artificially created in the anechoic chamber. For the supersonic tip speed data points, where the noise source mechanisms were dominated by multiple pure tones, there was little significant change in BPF power levels. These results indicated that large-scale inlet flow disturbances, which can occur during static tests, will have a greater acoustic impact on aircraft engines with subsonic relative tip speed fans.

The flow visualization and hot-film measurements indicated that reverse flow was found to occur along the exterior cowl in the anechoic chamber. This appears to be a prime candidate for producing inlet disturbances, in addition to those which were generated intentionally. These disturbances came from flanges, instrumentation probes and leads, and actuator support and drive mechanisms. Such disturbances are likely to occur in all static test facilities, and they provide further explanation for the variance between flight and projected static acoustic data.

Several methods of simulating flight in a static test situation have been attempted by others. These included introducing relative forward motion in a wind tunnel (Ref. 5) or with blowers (Ref. 6) and reducing inlet distortions with large honeycomb or mesh screen structures (Refs. 3, 6, and 14). Each method seems to have its own drawbacks, and to date nothing has been attempted to specifically reduce the inflow distortions arising along the exterior cowl of the inlet duct. Further, such methods as described above are rather difficult to accomplish in an anechoic chamber while retaining its desirable acoustic features. An attempt will be made to eliminate all protuberances in the fan inlet flow in the anechoic chamber, at which time these experiments should be repeated.

Section 7

ACKNOWLEDGMENTS

The authors are indebted to E.M. Birbilis, R.E. Otten, and R.E. Warren of General Electric Corporate Research and Development and to G. Dollinger of Yale University, a summer employee at CRD, for their assistance in carrying out the experiments and data reduction for the tests described in this report. Support of this research by the National Aeronautics and Space Administration under contract NAS 3-17853 (Dr. James H. Dittmar, Project Manager), issued by the V/STOL and Noise Division, NASA Lewis Research Center, Cleveland, Ohio, is gratefully acknowledged.

APPENDIXES

Appendix I

HOT FILM SYSTEM

Figure 11 is the schematic diagram of the hot film and its data acquisition system. The hot-film probes used were TSI model 1240 cross-flow X-probes, each probe having two sensors, at 90° to each other and perpendicular to the probe axis. Such probes are suited for measurements of two turbulence components, correlations, and flow vectors in two-dimensional flows. The signal from each individual sensor was fed into a constant-temperature anemometer with a built-in linearizer (TSI model 1054 A). The output signals from both anemometers were then input to the sum-and-difference module (TSI model 1063). The sum (A + B) and difference (A - B) of the outputs from the X-hot-film sensors are related to the velocity components of the two-dimensional flow when the orientation of the two sensors with respect to flow direction is known. In the work reported here, the two sensors of the X hot film were at + 45° with respect to the main flow direction (the axis of the fan) (see Figure 12). The output (A + B) represented the velocity measured along axial and radial directions: (A + B) = K(u + w) where K = constant obtained via calibration, u = axial velocity component, and w = radial velocity component.

Similarly, the output (A - B) represented the circumferential velocity component, v, in (A - B) = K'v where K' = constant obtained via calibration. For the inlet flow configuration, the mean and the turbulent velocities in the radial direction should be of the same magnitude as those in the circumferential direction. The mean circumferential velocity was found about one order-of-magnitude smaller than the mean axial velocity in the present experiments. Thus, the measured mean sum (A + B) from the X-probe was used to represent the mean axial velocity. For the turbulence measurement, the radial turbulent velocity was the same magnitude as the axial turbulent velocity. The actual axial turbulent velocity should be close to half the value measured from the (A + B) output.

The two sensors on the X-hot-film probe were, at first, calibrated independently in the potential core of the jet from a standard ASME nozzle of 1.78 cm (0.7 in.) diameter perpendicular to the flow direction. The slope and the span of the two linearized sensor outputs were matched to within ±1% of the full-scale value at air jet velocity of 150 m/s (500 ft/sec). The sensors were then rotated to approximately 45° with respect to the flow direction, until the output from the sum (A + B) reached the maximum, and the angular position was recorded as θ_1. A similar rotation of the sensors was also performed until the output from the "diff" (A - B) reached zero and was recorded as θ_2. The final angular position of the X hot film was set at the bisector of θ_1 and θ_2. Flow calibration on the (A + B) output was performed similarly to that for the single sensor. Figure 38 shows a typical calibration curve of flow velocity vs (A + B) output used in the inlet turbulence study.

The mean and turbulence velocities in the axial and the circumferential directions were obtained as the mean and the root-mean-square (rms) values of the outputs from (A + B) and (A - B). A TSI model 1976 dc voltmeter and a TSI model 1060 rms meter were used to obtain the mean and the turbulence velocities, respectively. A time constant of 0.1 sec was used for the on-line X-Y,Y plots and 10 sec was used for the off-line measurements. A pair of Kron-Hite low pass filters at 5 kHz were used before the dc voltmeter and the rms meter to remove the high-frequency noise from the anemometer.

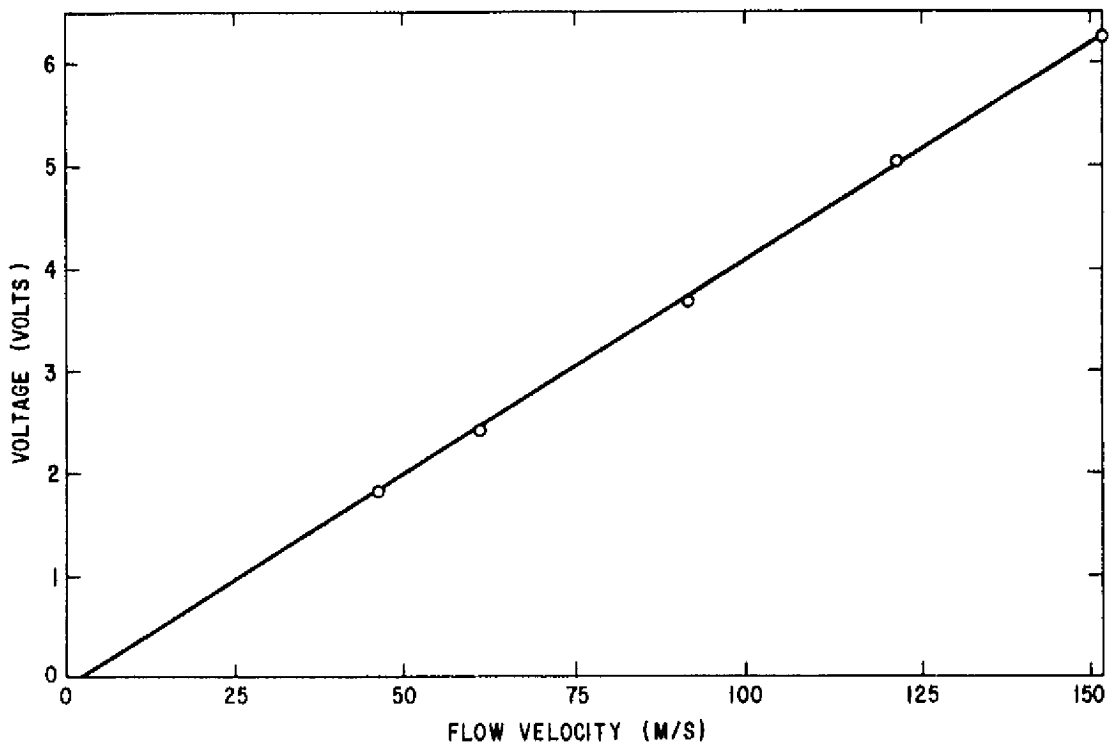


Figure 38. X-Hot-Film Calibration (A + B) Flow at 45° to the Sensors

To record the hot-film signals on magnetic tape for off-line data reduction and to obtain auto- and cross-correlation functions as well as turbulence spectra on-line, the high dc value associated with the hot-film signals had to be removed. Because of the low-frequency nature of the inlet turbulence, usual ac coupling devices for the dc value removal were not satisfactory. A pair of Tektronix 500-AM2 differential amplifiers were used as the dc level suppressors. Low-frequency signals of the order of 0.01 Hz were demonstrated to be preserved after these dc suppressors. However, the dc value could not be suppressed completely during most measurements. The small dc value remaining in the hot-film signal was found to raise the dc offset in the auto-covariance function at long time delay; i.e., $R(t \simeq \infty)$. One had to be careful about this dc offset in the turbulent length scale measurements from the auto-covariance functions. Sufficient delay time was needed to identify this dc offset value, and then to remove it before calculating the turbulence length scale value.

Let the instantaneous velocity, U(t), at time, t, be separated into a mean velocity, $\bar{U}$, and an instantaneous velocity perturbation, u'(t); i.e.:

$$U(t) = \bar{U} + u'(t) \qquad (A\text{-}1)$$

The correlation function is defined as the expectation of the quantity $[U(t)U(t+\tau)]$ at τ, which is the time separation between the two velocity measurements. This can be expressed as

$$R(\tau) = E\,[U(t)U(t+\tau)] \qquad (A\text{-}2)$$
$$= \bar{U}^2 + C(\tau)$$

where E [ ] denotes the expectation value and $C(\tau)$ is the covariance function coefficient at delay time τ. Since the value of $C(\tau)$ at infinite time delay is zero, one can obtain the value of $\bar{U}^2$ as

$$\bar{U}^2 = \lim_{\tau \to \infty} R(\tau) \qquad \text{(A-3)}$$

In other words, if one can measure the correlation function for a long enough time delay interval, he can subtract the value of $R(\tau)$ from Equation A-2 to obtain the covariance function

$$C(\tau) = R(\tau) - \lim_{\tau_o \to \infty} R(\tau_o) \quad . \qquad \text{(A-4)}$$

In practice, one has to choose a finite time window, T, such that $T << \infty$. The estimate of the covariance function coefficient can be obtained from the correlation function measurement as

$$\hat{C}(\tau) = R(\tau) - R(T) \quad . \qquad \text{(A-5)}$$

The accuracy of this covariance estimate depends on how close the value of R(T) is to the value of $\bar{U}^2$. In other words, the longer the time window interval one has, the better covariance function estimate he will get. The criteria for determining the length of the delay time window and the accuracy of the covariance function estimates depend on the nature of the covariance function. For a commonly encountered exponential form covariance function,

$$C(\tau) = C(0)e^{-\tau/\tau_I} \qquad \text{(A-6)}$$

where τ_I = the characteristic time scale at which the value of the covariance function reaches (1/e). The turbulence length scale L can be found by the definition,

$$L = \frac{\bar{U}}{C(0)} \int_o^\infty C(\tau)\, d\tau = \bar{U}\, \tau_I \qquad \text{(A-7)}$$

The measured turbulence scale, $\hat{L}$, based on the measured covariance function estimate $\hat{C}(\tau)$ can be found as

$$\hat{L} = \frac{\bar{U}}{\hat{C}(o)} \int_o^T \hat{C}(\tau)d\tau = \frac{\bar{U}\tau_I}{1-e^{-T/\tau_I}} \left[1-e^{-T/\tau_I}\left(1+\frac{T}{\tau_I}\right)\right] \qquad \text{(A8)}$$

Substituting Equation A-7 into Equation A-8 and rearranging some of the terms, one obtains

$$\frac{\hat{L}}{L} = 1-\left(\frac{T}{\tau_I}\right)\left[\frac{1}{e^{T/\tau_I}-1}\right] \qquad \text{(A-9)}$$

A plot of $(\hat{L}/L)$ versus (T/τ_I) is shown in Figure 39. An accuracy of the turbulence length scale estimate above 99% will be obtained if the time delay window interval is of the order of ten times the characteristic time of the covariance function. Two turbulence length scale measurements with delay time window interval of 5 to 10 times difference were used as a validation check for the measurement.

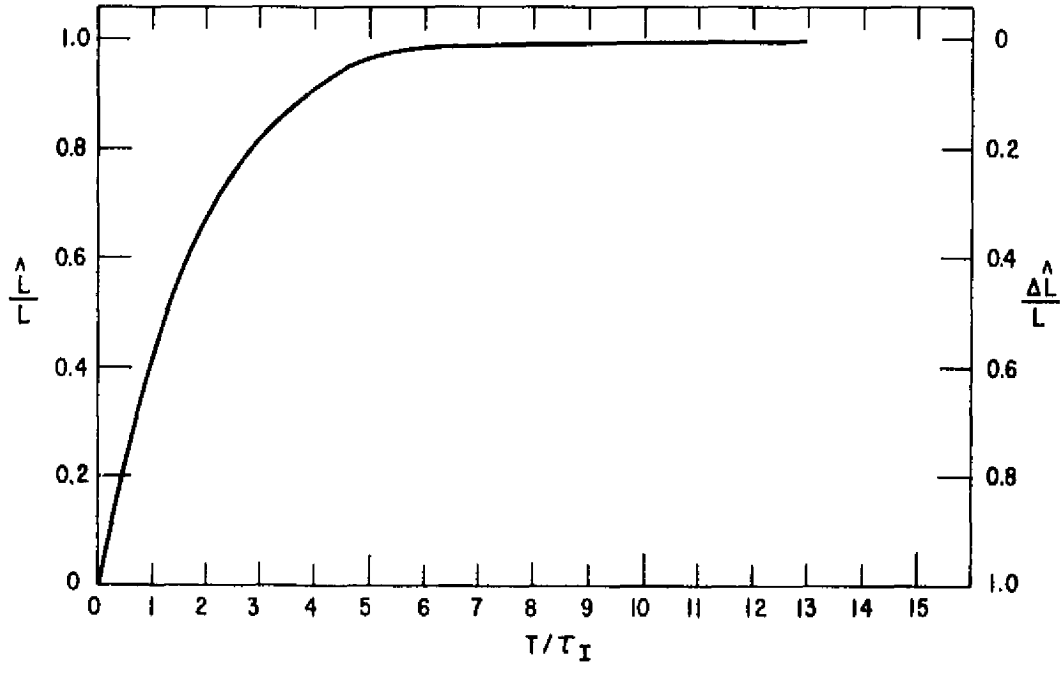


Figure 39. Effect of Time Delay Window Length on the Turbulence Length Scale Measurement for an Exponential Covariance Function

Appendix II

TABULATION OF 1/3 OCTAVE ACOUSTIC DATA

Tables 2 to 36 contain the 1/3-octave noise spectra for all tests carried out during this program. The sound pressure levels (SPL) from 100 Hz to 80 kHz measured at each of the microphone positions from 0^{o} to 110^{o} have been corrected to standard day conditions. Information describing the actual test point conditions is listed in the far-left side of each SPL table. Overall calculated sound pressure levels (OASPL) are compiled under each SPL spectrum. The sound power levels (PWL) for each 1/3-octave band are listed at the right of the SPL spectra, and an overall sound power level (OAPWL) is listed under the column. The nomenclature used in these tables is as follows:

BAR	Barometric Pressure
FREQ	1/3-Octave-Band Center Frequencies
HACT	Actual Humidity
NFA	Actual Fan Speed
NFD	Design Fan Speed
NFK	Corrected Fan Speed
OAPWL	Overall Sound Power Level Calculated by Summation of Power Level Spectra from 100 Hz to 80 kHz
OASPL	Overall Sound Pressure Level Calculated by Summation of Sound Pressure Levels at each 1/3 Octave from 100 Hz to 80 kHz
PWL	Sound Power Level, Re 10^{-13} watts
SPL	Sound Pressure Level, Re 0.0002 dynes/cm^2
TAMB	Ambient Temperature
TWET	Wet Bulb Temperature

Table 2

MODEL SOUND PRESSURE LEVELS (59°F, 70% Relative Humidity, Day)

Angles from Inlet in Degrees (and Radians)

BASELINE CLEAN CHAMBER
CORRECTED SPEED = 54%

		0.	10.	20.	30.	40.	50.	60.	70.	80.	90.	100.	110.	
	FREQ	(0.)	(0.17)	(0.35)	(0.52)	(0.70)	(0.87)	(1.05)	(1.22)	(1.40)	(1.57)	(1.75)	(1.92)	PWL
	50													
	63													
RADIAL 17. FT.	80													
(5.1)	100	72.2	72.3	71.3	69.0	67.0	69.1	70.7	71.3	70.1	70.2	69.7	66.3	103.0
VEHICLE R=11	125	74.0	73.3	71.0	69.1	70.3	70.1	70.7	71.3	70.8	70.3	70.4	70.0	104.2
CONFIG DF 6	160	69.7	68.3	68.3	69.1	68.0	68.1	68.7	69.0	68.1	65.7	65.2	67.0	100.7
DUC SCHENECTADY	200	74.3	73.3	73.1	73.0	71.3	70.8	69.2	69.0	68.1	67.3	64.9	64.3	103.4
DATE 5/19/76	250	80.0	79.0	78.0	77.0	76.3	74.9	72.9	71.8	70.8	70.7	69.1	68.3	107.3
RUN 8/4	315	78.7	78.3	77.0	75.8	75.8	74.1	72.8	71.3	69.1	68.0	68.4	64.8	106.2
TAPS	400	74.7	74.3	73.8	73.0	71.3	70.1	69.1	67.3	65.3	65.2	62.2	59.8	102.3
BAR 29.9 HG	500	72.3	71.3	71.0	71.0	71.1	69.8	68.4	67.3	63.8	64.9	61.7	60.3	101.0
(00973. N/M2)	630	74.3	74.3	74.1	73.7	72.3	71.0	68.4	67.3	66.0	63.7	63.0	61.0	102.0
TAMB 43. DEG F	800	73.2	73.0	72.0	72.2	70.3	69.3	67.1	65.3	63.3	63.4	62.2	59.3	101.2
(279. DEG K)	1000	69.9	70.8	70.8	70.2	69.3	68.1	65.8	65.0	64.3	60.7	58.7	57.2	99.4
INLT -40. DEG F	1250	70.4	72.0	71.8	71.3	70.3	68.8	68.4	64.3	61.8	60.2	59.3	57.8	100.2
(278. DEG K)	1600	72.3	72.8	72.0	71.8	71.8	70.8	68.4	65.5	62.8	62.9	58.9	57.3	101.3
HADT 5.65 GM/MJ	2000	75.0	75.3	74.8	74.8	74.8	73.6	71.3	68.3	65.8	64.4	60.2	60.0	104.3
(.00963 AG/MJ)	2500	77.3	77.3	76.9	77.1	76.3	76.1	74.3	71.0	67.8	68.1	62.7	61.4	106.8
NFA 8077. RPM	3150	79.7	79.1	78.8	78.8	78.3	77.8	75.8	74.9	69.3	68.8	65.4	62.7	108.2
(846. RAD/SEC)	4000	81.2	81.3	81.3	81.6	81.7	80.7	78.8	78.0	71.3	69.3	66.7	65.6	111.2
NFA 8716. RPM	5000	83.8	84.7	84.3	84.8	84.9	83.8	82.2	77.9	73.9	72.2	69.5	68.8	114.3
(912. RAD/SEC)	6300	86.3	86.3	85.1	85.5	85.9	84.1	84.2	81.2	80.3	80.5	80.8	80.0	125.5
NFD 16100. RPM	8000	82.4	84.2	84.7	84.9	85.3	85.8	82.9	79.8	76.9	74.8	69.8	68.7	115.3
(1686. RAD/SEC)	10000	84.3	85.2	85.7	86.3	87.4	87.8	85.4	81.4	78.2	78.1	78.9	69.2	117.3
NO. OF BLADES 44	12500	86.1	85.8	86.2	85.3	85.8	85.1	82.3	80.3	80.3	79.7	77.2	76.7	124.2
FAN TIP SPEED	16000	84.2	85.3	87.2	87.8	88.0	88.6	85.8	82.3	78.8	78.8	78.3	80.4	116.1
744. FT/SEC	20000	83.7	87.3	88.3	89.1	90.4	92.2	89.5	87.2	83.3	79.9	76.7	77.1	123.8
	25000	82.1	84.2	86.4	86.2	86.3	86.9	87.7	83.8	78.9	71.3	68.8	68.8	120.2
	31500	80.3	81.7	84.3	86.2	86.3	87.1	85.7	82.1	74.8	69.7	64.8	63.8	119.2
	40000	77.8	79.2	81.9	83.1	83.7	84.2	83.8	78.3	70.1	68.2	61.8	60.5	117.7
	50000	77.7	79.8	80.8	81.3	82.3	82.9	80.4	78.2	67.8	65.8	60.9	61.1	117.8
	63000	76.1	78.7	78.8	79.4	79.7	80.1	77.8	73.2	69.8	65.8	62.8	60.8	116.8
	80000	69.3	70.2	72.3	72.8	73.4	72.8	70.8	68.7	63.2	58.7	58.9	58.7	113.8
OVERALL CALCULATED		88.7	88.2	88.9	100.8	101.8	100.1	98.8	93.8	90.3	87.9	84.8	83.8	131.7

Table 3

MODEL SOUND PRESSURE LEVELS (59°F, 70% Relative Humidity, Day)

Angles from Inlet in Degrees (and Radians)

BASELINE CLEAN CHAMBER

CORRECTED SPEED = 69%

FREQ	0. (0.)	10. (0.17)	20. (0.35)	30. (0.52)	40. (0.70)	50. (0.87)	60. (1.05)	70. (1.22)	80. (1.40)	90. (1.57)	100. (1.75)	110. (1.92)	PWL
50													
63													
RADIAL 17. FT. 80													
(5. M) 100	73.3	73.3	73.0	71.9	69.0	70.5	72.0	72.0	72.7	72.1	72.4	70.3	105.0
VEHICLE K=11 125	74.5	75.5	72.0	70.0	71.1	70.5	70.3	71.0	71.4	71.3	70.9	69.5	104.0
CONFIG CF 0 160	72.0	71.0	71.3	72.5	71.3	70.0	70.0	69.3	66.4	70.0	69.9	69.0	103.9
LOC SCHENECTADY 200	77.0	76.3	77.0	75.4	74.3	74.0	71.7	71.5	70.9	72.3	70.9	71.0	106.7
DATE 3/19/76 250	82.3	81.3	80.8	81.1	79.3	77.0	75.3	74.0	72.7	73.0	71.0	69.3	109.0
RUN 8/5 315	81.0	81.3	80.5	80.0	79.1	77.3	75.3	74.0	71.7	72.1	69.9	67.8	109.4
TAPE 400	79.3	78.3	77.8	77.8	76.1	74.8	73.3	72.0	69.8	70.0	68.4	64.0	106.9
BAR 29.9 IN 500	76.8	75.3	75.3	75.0	75.1	74.0	73.2	71.5	70.4	70.3	69.3	65.3	106.1
(00973. N/M2) 630	76.0	76.0	76.0	79.1	77.3	75.3	73.3	72.5	70.9	71.0	68.7	65.0	107.0
TAMB 43. DEG F 800	77.0	77.3	77.3	77.3	76.0	74.7	73.2	70.8	69.1	74.9	68.4	65.7	107.1
(279. DEG K) 1000	74.0	74.5	75.0	75.3	75.1	73.0	71.2	70.0	68.1	68.0	64.3	63.3	104.8
DEW 40. DEG F 1250	73.8	74.3	74.5	74.8	73.8	72.5	70.2	68.8	68.4	67.3	61.9	61.2	103.8
(276. DEG K) 1600	75.0	75.0	75.0	76.1	75.0	74.3	73.0	70.1	68.1	67.3	63.1	61.7	105.5
HAGT 5.65 GM/MJ 2000	77.0	77.0	77.0	78.9	77.3	76.7	75.2	74.0	68.0	68.9	64.2	63.2	107.0
(.00365 KG/M3) 2500	79.1	78.1	78.3	80.1	78.3	77.5	76.2	75.3	69.7	69.3	65.4	64.4	108.8
NFA 10951. RPM 3150	81.0	82.1	81.3	82.2	81.0	80.9	78.7	78.0	71.9	69.2	67.7	67.2	111.4
(1147. RAD/SEC) 4000	83.3	84.3	84.0	84.4	84.0	83.9	83.3	79.7	75.0	74.0	71.3	70.0	114.5
NEA 11124. RPM 5000	83.7	84.3	84.9	85.0	85.0	84.0	83.0	80.7	77.0	75.9	72.4	71.3	115.3
(1165. RAD/SEC) 6300	85.3	86.0	86.0	87.1	89.3	87.0	86.3	86.3	81.4	79.3	78.0	74.3	118.8
NFB 10120. RPM 8000	90.0	95.3	97.4	100.9	103.8	104.5	105.0	104.1	97.7	95.3	93.3	90.9	135.2
(1060. RAD/SEC) 10000	85.6	87.4	87.9	90.3	90.7	90.8	90.3	88.4	82.0	79.7	78.2	74.9	121.3
NO. OF BLADES 44 12500	88.0	88.0	87.9	91.0	91.2	91.0	90.8	87.3	81.9	79.6	78.2	73.2	121.9
FAN TIP SPEED 15000	92.3	93.2	94.1	96.9	97.0	99.0	96.8	93.0	89.3	85.7	82.0	79.9	129.4
948. FT/SEC 20000	87.0	88.2	90.2	92.7	92.4	90.9	90.8	87.7	80.9	77.7	73.7	70.9	123.1
25000	88.7	89.3	93.3	94.8	95.0	95.8	94.8	91.3	85.3	81.2	78.3	73.9	127.2
31500	87.2	88.2	90.8	93.8	93.3	92.8	93.1	89.2	82.4	78.0	74.9	68.8	120.1
40000	84.4	85.6	87.4	89.9	90.2	90.3	89.8	86.0	79.2	75.3	68.3	65.0	124.3
50000	82.3	83.8	85.0	88.3	88.1	88.5	87.7	84.2	77.4	73.8	68.4	63.1	124.3
63000	80.4	81.7	83.0	85.0	86.0	86.5	85.2	81.3	74.7	70.8	68.3	61.9	124.4
80000	74.3	74.7	76.7	77.8	78.4	78.5	78.4	74.3	68.8	67.9	58.9	57.2	121.2
OVERALL CALCULATED	100.4	100.7	102.4	103.8	103.3	102.8	101.8	98.2	90.8	84.3	81.2	78.3	138.3

Table 4

MODEL SOUND PRESSURE LEVELS (59°F, 70% Relative Humidity, Day)

Angles from Inlet in Degrees (and Radians)

BASELINE CLEAN CHAMBER

CORRECTED SPEED = 86%

RADIAL 17. FT. (5. M)
VEHICLE R=11
CONFIG DF 6
LOC SCHENECTADY
DATE 3/19/76
RUN 6/6
TAPE
BAR 29.9 MB (09973. N/M2)
TAMB 43. DEG F (279. DEG K)
THET 39. DEG F (277. DEG K)
HACT 5.12 GM/M3 (.00512 KG/M3)
NFA 13649. RPM (1429. RAD/SEC)
NFS 13865. RPM (1452. RAD/SEC)
NFU 16100. RPM (1686. RAD/SEC)
NO. OF BLADES 44
FAN TIP SPEED 1182. FT/SEC

PNL	0. (0.)	10. (0.17)	20. (0.35)	30. (0.52)	40. (0.70)	50. (0.87)	60. (1.05)	70. (1.22)	80. (1.40)	90. (1.57)	100. (1.75)	110. (1.92)	PNL
1000	67.1	67.3	67.0	67.1	65.3	70.7	70.2	71.7	71.8	79.3	76.0	74.1	106.0
1250	68.0	69.0	68.3	69.9	67.3	72.2	70.2	71.0	70.9	80.9	79.0	74.1	107.8
1600	69.1	67.3	67.6	68.9	66.1	73.0	72.3	73.2	69.6	81.0	72.0	75.0	108.8
2000	62.3	62.8	61.8	63.6	62.1	79.2	78.2	78.5	75.0	83.2	74.2	73.8	113.2
2500	64.0	64.3	63.3	65.1	83.8	80.3	77.7	77.2	76.0	83.3	73.6	76.3	114.2
3150	78.3	75.9	73.5	73.1	73.0	80.2	71.2	71.7	99.0	84.9	99.2	73.5	111.4
4000	75.3	74.3	74.0	74.6	72.0	79.3	71.7	70.3	87.2	85.0	94.0	76.0	111.6
5000	73.3	73.3	73.0	74.3	73.3	75.7	71.7	72.0	87.2	86.0	89.0	78.0	111.0
6300	76.3	77.0	77.3	78.0	75.0	74.5	74.2	73.2	73.2	87.3	87.3	78.3	113.2
8000	73.0	74.0	74.3	73.0	74.3	74.4	74.3	77.2	87.2	87.3	88.0	77.3	113.3
10000	76.3	76.0	75.3	75.8	75.1	75.7	74.2	73.0	74.4	86.2	88.0	81.3	113.1
12500	79.0	79.0	78.3	77.0	78.0	79.4	78.7	79.5	78.2	88.3	76.7	83.0	113.3
16000	76.3	76.0	77.0	77.0	78.1	78.4	77.3	77.3	72.0	85.3	88.2	83.0	113.8
20000	81.0	84.1	81.1	84.1	85.1	86.7	86.0	83.8	81.7	87.0	77.3	86.2	118.1
25000	82.0	82.0	83.1	87.2	89.3	90.9	94.2	97.3	93.2	89.7	84.0	87.0	125.0
31500	86.0	88.1	87.0	87.4	93.3	98.2	100.7	101.5	99.2	93.2	90.1	89.0	130.8
40000	91.3	92.0	93.0	99.4	100.5	106.1	109.4	108.5	105.4	100.3	101.0	97.9	136.3
50000	97.3	98.7	98.9	98.9	98.4	107.3	111.3	108.7	108.1	101.0	99.3	98.1	139.4
63000	92.0	90.8	92.0	93.3	95.0	100.7	105.0	104.5	100.5	96.5	90.7	92.1	134.0
80000	94.0	94.8	93.5	96.0	97.4	100.0	104.3	103.0	99.8	96.8	92.4	89.5	133.7
100000	103.9	104.3	105.2	106.9	107.3	107.3	109.8	107.4	102.7	100.3	96.3	94.0	139.3
125000	94.3	94.1	93.7	96.0	98.8	99.5	102.7	102.3	98.9	93.7	89.2	87.3	132.8
150000	94.2	93.8	95.0	97.3	97.9	99.1	101.3	100.0	96.6	92.0	87.3	84.7	131.9
200000	96.1	96.9	97.0	99.3	99.8	99.9	101.2	99.8	94.9	91.9	93.9	86.3	132.3
250000	93.3	93.4	94.2	96.2	96.3	97.4	98.7	97.6	92.7	89.3	84.8	80.0	130.3
315000	93.2	92.2	94.1	95.5	95.8	96.5	97.1	95.1	90.3	87.3	79.3	76.1	130.0
400000	90.3	89.9	91.3	93.2	93.2	94.0	95.0	93.3	87.8	85.0	78.1	76.3	129.1
500000	88.9	88.3	90.0	91.3	91.7	91.9	93.4	91.0	86.0	83.9	78.9	78.3	129.3
630000	85.0	85.7	85.7	86.5	86.7	89.7	90.0	89.9	84.5	81.3	76.4	76.2	129.3
800000	77.3	77.3	79.2	80.1	80.9	83.2	84.2	82.7	78.1	76.0	69.7	73.2	128.9
OVERALL CALCULATED	107.2	107.4	108.3	110.4	110.9	113.4	116.3	113.3	111.2	107.9	103.9	103.3	140.2

Table 5

MODEL SOUND PRESSURE LEVELS (59°F, 70% Relative Humidity, Day)

Angles from Inlet in Degrees (and Radians)

FREQ.	0. (0.)	10. (0.17)	20. (0.35)	30. (0.52)	40. (0.70)	50. (0.87)	60. (1.05)	70. (1.22)	80. (1.40)	90. (1.57)	100. (1.75)	110. (1.94)	PWL
					BASELINE CLEAN CHAMBER								
RADIAL 1Z. FT.					CORRECTED SPEED = 90%								
(3. M)	100	84.8	84.3	84.3	84.4	85.3	86.0	86.2	81.0	80.3	82.0	85.0	81.1	103.9
VEHICLE R-11	125	85.3	87.3	88.8	89.1	85.3	86.0	86.2	81.0	85.3	83.3	87.8	83.8	104.3
CONFIG 0F 0	160	88.3	88.8	88.8	87.9	82.3	82.2	82.3	82.7	85.8	84.3	82.8	86.1	106.4
LOC SOMEWECTAWY	200	83.4	82.8	82.3	81.9	82.3	81.7	82.8	82.8	80.3	84.3	88.3	82.3	105.4
DATE 3/19/76	250	82.3	80.8	79.3	80.4	78.3	79.8	77.2	78.7	78.7	79.3	77.8	78.3	112.1
RUN 8/Z	315	83.3	82.8	82.8	82.8	81.7	80.2	80.4	80.8	87.8	84.3	89.3	89.3	105.7
TAPE	400	81.8	81.3	81.3	82.1	81.8	78.3	78.2	83.3	85.5	78.8	88.8	83.8	105.3
BAR 29.9 MB	500	82.3	83.8	83.3	83.8	83.7	83.2	81.7	80.8	85.2	83.8	89.8	85.3	105.8
(00973. N/M2)	630	83.8	83.5	84.8	84.8	84.2	82.2	80.2	80.8	88.8	84.8	88.8	87.8	107.7
TAMB 43. DEG F	800	82.3	82.8	83.8	83.8	83.8	83.2	81.8	81.8	80.2	84.7	84.8	83.8	108.3
(279. DEG K)	1000	83.3	84.8	84.8	88.8	87.7	87.2	84.2	87.8	83.2	88.2	85.8	88.8	110.4
THET 49. DEG F	1250	91.3	89.3	87.8	89.3	83.3	82.4	80.2	82.7	81.7	83.3	78.8	78.3	115.0
(277. DEG K)	1600	91.1	89.3	88.3	88.3	82.2	85.4	87.8	88.3	83.8	84.7	87.3	88.3	117.3
HACH 5.12 GM/M3	2000	83.8	96.3	91.1	91.4	97.7	102.7	104.8	102.3	97.8	97.3	94.8	94.8	133.3
(.00312 KG/M3)	2500	81.8	83.8	83.1	90.2	93.7	98.4	99.9	99.8	93.7	94.7	92.8	89.3	129.8
NFA 14274. RPM	3150	85.3	87.8	85.3	88.4	94.7	101.9	102.9	103.3	97.7	95.7	93.3	93.3	132.8
(1494. RAD/SEC)	4000	91.8	93.3	95.3	97.1	105.4	109.8	111.4	109.8	105.7	102.1	101.1	101.9	140.2
NFA 14499. RPM	5000	96.2	98.8	98.2	97.4	103.1	110.8	111.9	107.4	103.1	100.8	98.1	99.1	139.4
(1518. RAD/SEC)	6300	92.9	92.8	90.1	87.3	97.7	103.7	105.5	102.7	98.2	98.8	96.4	91.1	134.2
NFA 14100. RPM	8000	93.3	94.3	94.7	98.2	101.3	103.3	103.8	101.8	97.8	94.9	89.9	87.8	133.3
(1500. RAD/SEC)	10000	107.7	105.3	100.2	100.1	108.1	108.8	110.8	107.7	102.9	97.3	98.1	94.8	140.3
NO. OF BLADES 44	12500	97.8	97.1	98.3	101.7	101.2	103.3	103.2	102.8	97.8	93.7	88.1	87.8	134.7
FAN TIP SPEED	15000	94.4	94.8	93.7	98.8	99.3	100.8	102.3	99.9	94.9	91.3	88.3	84.2	132.4
1250. FT/SEC	20000	87.1	88.3	87.8	100.1	101.8	101.4	103.7	100.8	98.8	91.3	88.4	83.8	133.9
	25000	93.8	93.9	93.2	87.2	98.4	98.9	101.2	98.1	92.7	88.3	83.3	80.3	131.9
	31500	92.9	93.3	94.8	98.3	97.8	98.8	99.8	98.9	90.5	87.1	83.8	77.8	131.3
	40000	89.3	89.9	91.8	93.7	94.1	95.3	97.8	93.7	87.8	84.3	78.1	75.3	130.1
	50000	85.2	88.7	90.2	92.2	92.4	93.9	95.9	92.8	85.9	83.7	74.4	73.3	130.7
	63000	83.8	85.4	87.4	89.8	89.3	91.7	93.4	90.7	84.8	81.8	73.4	77.8	130.9
	80000	77.3	78.7	79.2	80.8	83.3	84.7	87.1	84.2	77.4	75.7	68.7	74.2	128.3
OVERALL CALCULATED		109.3	108.1	109.2	111.4	113.1	116.3	117.8	115.2	111.9	107.9	105.9	105.3	147.3

Table 6

MODEL SOUND PRESSURE LEVELS (59°F, 70% Relative Humidity, Day)

Angles from Inlet in Degrees (and Radians)

BASELINE CLEAN CHAMBER

CORRECTED SPEED = 100%

RADIAL 17. FT.	FREQ.	0. (0.)	10. (0.17)	20. (0.35)	30. (0.52)	40. (0.70)	50. (0.87)	60. (1.05)	70. (1.22)	80. (1.40)	90. (1.57)	100. (1.75)	110. (1.92)	PWL
(5. M)	100	82.3	82.3	84.3	85.9	89.5	70.0	70.2	72.5	72.3	73.0	71.3	71.0	104.7
VEHICLE R=11	125	84.9	89.2	88.0	82.9	89.3	70.0	70.2	71.3	72.3	73.9	73.9	73.9	105.3
CONFIG DF 6	160	89.0	87.8	87.3	87.9	71.7	72.5	73.2	74.0	73.5	75.0	70.3	77.1	107.9
LOC SCHENECTADY	200	83.3	83.3	82.8	83.9	89.3	70.0	70.2	70.0	84.2	70.9	83.0	71.3	102.5
DATE 3/19/76	250	73.3	72.3	70.8	74.4	79.3	80.3	82.2	82.7	82.4	77.0	79.3	81.3	114.1
RUN 8/8	315	88.3	89.0	89.3	70.1	71.7	72.0	72.2	72.7	71.2	73.8	83.8	78.3	106.2
TAPE	400	85.0	84.8	88.0	87.6	89.3	70.0	70.2	70.0	84.2	70.8	83.8	78.3	105.1
BAR 29.9 MB	500	87.3	71.3	70.3	77.8	77.3	78.0	78.0	81.0	78.3	78.0	88.0	73.3	110.7
(0099/3, N/M2)	630	87.3	87.3	88.3	89.1	70.2	70.2	70.2	71.3	87.0	78.8	82.8	79.3	107.0
TAMB 44. DEG F	800	89.8	87.3	83.8	78.3	79.3	78.4	78.3	78.2	77.8	77.2	73.8	77.2	111.4
(280. DEG K)	1000	70.3	78.3	71.8	78.0	84.0	85.7	88.8	88.2	88.2	82.3	81.8	79.0	117.7
IAET 40. DEG F	1250	74.8	79.1	74.8	88.3	93.2	94.4	93.2	93.0	89.7	83.0	83.4	83.0	125.1
(278. DEG K)	1600	73.8	82.1	84.8	94.8	98.2	98.9	99.2	93.8	93.3	92.2	89.2	88.3	128.3
HACI 5.35 GM/M3	2000	79.8	88.8	83.3	98.1	94.3	97.4	97.4	94.8	92.7	90.7	88.3	88.7	127.1
(.00335 KG/M3)	2500	82.8	87.1	84.8	87.4	98.2	102.2	102.7	101.3	98.8	95.2	93.8	88.3	131.8
NFA 15079. RPM	3150	83.8	83.3	83.8	87.2	90.7	98.4	97.2	98.3	91.8	89.1	83.8	83.7	128.3
(1582. RAD/SEC)	4000	88.8	88.8	88.3	87.1	94.4	98.8	97.1	94.8	89.4	88.3	88.8	85.4	126.3
NFA 16110. RPM	5000	93.2	93.7	93.7	98.9	99.1	103.8	101.8	100.8	97.4	94.8	93.8	87.8	132.3
(1687. RAD/SEC)	6300	92.9	91.8	92.3	93.1	97.7	100.7	99.5	98.4	94.2	90.8	88.2	83.3	130.8
NFB 16100. RPM	8000	93.3	92.8	92.8	93.8	97.3	98.8	98.3	97.1	92.8	90.8	87.4	84.8	128.9
(1686. RAD/SEC)	10000	101.1	101.2	101.3	104.9	104.4	105.3	104.8	100.7	98.2	93.4	90.1	88.8	135.8
NO. OF BLADES 44	12500	107.3	107.1	106.8	108.4	111.2	112.7	110.9	108.8	104.3	98.4	94.1	94.1	141.8
FAN TIP SPEED	16000	93.9	94.3	94.9	97.2	98.3	101.8	100.4	98.3	91.8	88.8	83.3	82.2	130.8
1375. FT/SEC	20000	95.8	95.8	98.3	98.3	99.2	99.9	98.9	98.3	91.3	87.8	84.9	84.8	130.9
	25000	97.8	97.1	98.4	99.4	100.8	101.9	102.2	98.3	93.7	89.3	83.8	81.3	133.8
	31500	93.7	93.1	94.4	98.3	97.3	98.3	98.4	94.2	89.3	83.4	79.8	78.4	130.9
	40000	90.4	90.3	91.9	93.2	94.7	96.1	96.1	91.8	88.8	83.8	78.4	74.8	129.8
	50000	88.8	89.3	90.8	92.3	94.8	95.8	95.8	93.4	88.3	88.3	79.8	74.8	130.8
	63000	88.1	88.4	87.7	88.7	91.1	92.8	92.8	87.8	84.9	88.8	81.8	78.3	131.8
	80000	78.3	78.1	80.2	81.4	84.1	88.8	88.4	81.2	78.4	82.3	89.8	74.3	128.3
OVERALL CALCULATED		109.7	109.4	110.2	111.3	113.2	115.5	114.4	111.8	108.8	104.3	101.9	98.9	145.3

Table 7

MODEL SOUND PRESSURE LEVELS (59°F, 70% Relative Humidity, Day)

Angles from Inlet in Degrees (and Radians)

		0. (0.)	10. (0.17)	20. (0.35)	30. (0.52)	40. (0.70)	50. (0.87)	60. (1.05)	70. (1.22)	80. (1.40)	90. (1.57)	100. (1.75)	110. (1.92)	
	FREQ					BASELINE CLEAN CHAMBER								PWL
	50					CORRECTED SPEED = 86% (REPEAT)								
	63													
BAROMETER 17. IN.	80													
(5. M)	100	87.3	87.0	87.3	88.0	89.5	90.0	90.5	91.7	91.8	93.0	89.3	88.0	104.0
VEHICLE N=11	125	88.0	89.8	88.3	84.9	89.3	90.0	90.2	90.0	89.8	91.0	90.3	90.3	103.8
CONFIG OF 8	160	89.0	87.3	87.3	88.1	92.2	92.5	92.7	93.0	89.3	94.3	92.0	92.0	105.8
LOC SOMERSETAUT	200	90.3	91.3	90.8	91.9	90.7	90.7	97.3	97.2	93.8	98.8	93.0	92.0	111.2
DATE 3/19/76	250	92.3	92.5	91.3	89.9	92.5	90.5	99.0	98.2	98.7	97.8	94.0	94.0	112.9
RUN 829	315	98.3	95.8	93.3	93.3	94.0	92.7	91.7	91.0	88.8	93.3	88.3	87.8	105.8
TAPE	400	93.3	94.3	94.0	94.1	93.2	92.7	91.2	90.3	87.2	94.0	88.1	88.0	105.3
BAR 29.9 HG	500	94.3	93.8	94.0	94.1	93.2	92.2	91.2	90.3	87.3	93.3	89.0	89.0	105.0
(00973. N/M2)	630	97.0	97.3	97.0	97.1	95.7	94.5	93.0	91.5	90.3	98.3	89.3	87.0	107.8
TAMB 44. DEG F	800	93.0	93.3	94.0	93.3	94.7	93.2	92.0	90.7	88.8	98.2	88.8	88.3	106.8
(280. DEG K)	1000	98.3	98.3	95.3	95.3	95.2	95.7	94.7	94.7	94.8	97.3	87.4	87.0	108.3
TAET 40. DEG F	1250	91.0	88.3	98.0	97.0	98.2	88.4	98.4	98.2	98.4	91.7	92.6	92.8	112.1
(278. DEG K)	1600	97.3	98.0	98.1	98.0	98.7	98.9	98.2	93.0	92.2	97.2	88.3	92.3	110.0
HADT 5.35 GM/M3	2000	92.0	94.0	90.0	92.4	89.3	87.7	88.4	84.0	91.7	89.4	98.0	98.3	118.2
(.00535 KG/M3)	2500	92.0	92.0	94.1	97.9	98.5	91.2	94.4	97.0	93.0	97.7	93.1	87.0	125.4
NFA 13050. RPM	3150	98.1	99.8	98.3	97.2	93.7	98.4	100.7	101.0	99.2	96.4	89.8	88.3	130.9
(1430. RAD/SEC)	4000	91.3	93.0	92.2	99.1	100.1	105.8	110.1	108.7	105.4	100.3	101.0	96.4	136.6
NFA 13003. RPM	5000	96.3	95.3	96.7	97.4	98.0	108.5	110.0	109.2	105.9	101.9	99.1	98.1	139.0
(1451. RAD/SEC)	6300	92.0	91.0	90.1	94.0	94.9	100.7	106.0	104.9	100.7	96.3	94.2	92.0	134.0
NFD 10103. RPM	8000	93.0	93.3	93.7	99.2	97.3	100.3	104.3	103.3	99.0	93.0	92.7	89.3	133.7
(1066. RAD/SEC)	10000	103.9	94.7	103.3	107.0	107.9	107.5	109.3	107.2	101.9	99.7	95.0	93.3	139.4
NO. OF BLADES 44	12500	94.0	94.1	93.7	98.4	99.0	100.2	103.1	101.3	97.3	93.2	91.1	87.1	132.8
FAN TIP SPEED	16000	93.9	93.0	94.9	97.2	98.3	98.5	101.2	100.3	95.1	90.7	87.2	84.2	131.5
1183. FT/SEC	20000	98.1	98.3	97.3	99.3	99.4	99.9	100.9	99.0	93.0	89.9	85.3	81.3	132.2
	25000	92.3	92.0	94.4	93.9	96.0	97.1	98.9	98.3	91.7	87.3	82.3	79.0	130.2
	31500	93.2	92.3	93.9	93.0	95.8	98.3	97.1	94.9	90.3	86.9	79.9	78.7	130.1
	40000	89.9	90.3	91.4	93.0	93.2	93.8	94.3	92.3	87.0	83.3	78.2	74.9	128.7
	50000	88.8	88.3	89.8	91.0	91.3	92.3	93.3	91.4	88.2	83.0	74.3	74.9	129.3
	63000	85.3	85.4	86.9	88.2	88.8	89.8	90.8	89.4	85.4	79.8	71.3	70.1	129.3
	80000	78.1	77.8	77.3	80.4	82.3	83.3	85.4	83.3	77.9	74.1	69.9	67.9	130.2
OVERALL CALCULATED		107.2	107.3	108.4	110.7	111.1	113.3	116.4	115.1	110.9	107.2	103.3	103.2	146.2

Table 8

MODEL SOUND PRESSURE LEVELS (59°F, 70% Relative Humidity, Day)

Angles from Inlet in Degrees (and Radians)

BASELINE CLEAN CHAMBER

CORRECTED SPEED = 69% (REPEAT)

	FREQ.	0. (0.)	10. (0.17)	20. (0.35)	30. (0.52)	40. (0.70)	50. (0.87)	60. (1.05)	70. (1.22)	80. (1.40)	90. (1.57)	100. (1.75)	110. (1.92)	PWL
RADIAL 17. FT.	50													
(5. M)	80													
VEHICLE R=11	100	72.6	73.0	72.3	71.4	69.3	70.3	72.0	73.0	71.7	75.3	71.9	70.0	105.9
CONFIG CF 6	125	74.0	73.0	72.6	70.4	70.0	70.8	70.0	72.3	71.7	78.1	71.7	70.8	106.0
LOC SCHENECTADY	160	73.3	71.0	71.0	72.0	71.0	71.3	73.3	72.3	68.9	75.3	70.7	70.0	105.4
DATE 3/19/76	200	75.3	77.8	78.8	73.9	74.1	74.0	71.2	71.8	70.7	77.1	74.9	73.3	107.6
RUN 8/10	250	82.3	81.3	81.0	80.8	79.3	77.0	75.2	75.3	72.7	77.0	71.0	69.3	110.3
TAPE	315	82.3	81.0	81.0	80.8	79.1	77.8	75.7	75.0	72.2	79.1	69.6	68.3	110.5
BAR 29.9 MG	400	79.0	78.3	77.3	77.0	76.6	75.5	73.3	74.6	69.9	76.1	68.6	65.0	108.4
(30973. N/M2)	500	78.3	78.8	78.3	78.0	75.3	74.0	72.7	73.0	70.1	78.0	68.9	64.8	107.6
	630	78.6	78.6	78.6	78.6	77.6	75.6	74.2	75.3	71.1	80.6	68.9	66.8	109.7
TAMB 44. DEG F	800	78.3	77.0	77.6	78.0	76.6	74.7	72.7	75.3	69.1	80.3	67.7	65.7	109.1
(280. DEG K)	1000	74.3	74.3	74.6	75.6	74.6	73.0	70.7	73.5	67.6	79.3	64.0	67.2	108.7
TWET 40. DEG F	1250	73.6	74.3	75.0	74.8	73.6	71.7	70.2	70.3	65.1	81.3	67.2	65.2	108.9
(278. DEG K)	1600	75.3	75.1	75.6	75.6	75.3	73.5	71.7	68.1	65.9	79.3	64.6	65.0	108.9
HACT 5.35 GM/MO	2000	77.6	77.6	77.3	76.1	77.1	76.0	73.7	[illegible]	67.6	80.3	65.9	66.2	111.1
(.00535 KG/MS)	2500	78.6	78.1	78.3	79.4	78.1	77.7	75.9		69.2	79.2	64.9	65.9	109.6
NFA 10961. RPM	3150	81.1	81.3	81.3	82.2	81.3	80.7	78.7	75.3	71.4	77.4	67.3	69.4	111.9
(1148. RAD/SEC)	4000	83.6	84.0	84.0	84.4	84.0	83.6	82.6	79.5	76.1	76.0	71.2	70.0	114.3
NFN 11123. RPM	5000	83.7	83.2	83.2	86.6	85.4	85.1	84.0	80.2	78.0	77.0	72.0	70.3	115.7
(1165. RAD/SEC)	6300	85.4	87.0	87.3	88.6	88.7	88.8	86.0	86.2	80.7	80.0	76.0	73.3	119.4
NFD 16100. RPM	8000	96.3	96.3	97.3	101.7	103.6	104.6	104.3	103.6	96.0	95.3	91.6	89.0	134.9
(1686. RAD/SEC)	10000	87.1	87.2	88.0	90.1	91.0	90.8	90.3	86.0	83.1	82.6	77.4	74.3	121.4
NO. OF BLADES 44	12500	87.3	88.6	89.7	91.7	91.3	91.0	90.2	88.6	83.7	78.3	73.3	73.3	121.8
FAN TIP SPEED	16000	92.4	92.5	94.2	97.2	98.1	99.3	98.4	95.9	89.5	86.3	82.9	79.4	129.6
949. FT/SEC	20000	87.1	89.3	90.0	92.5	92.3	91.7	90.2	87.3	80.7	79.1	73.8	71.6	123.1
	25000	88.3	91.3	93.4	93.4	95.7	95.4	94.7	91.1	85.6	81.3	78.8	74.2	127.3
	31500	87.2	91.3	92.8	93.3	93.8	92.8	92.4	89.0	82.2	79.4	74.0	68.7	125.9
	40000	83.9	91.3	87.4	89.7	90.3	90.6	89.4	88.1	79.0	77.8	67.8	65.0	124.0
	50000	82.8	93.8	83.8	88.1	88.1	88.8	87.8	84.7	77.1	77.1	65.9	64.1	125.0
	63000	88.3	93.8	83.2	84.9	85.8	86.2	85.1	81.4	74.8	77.1	63.2	63.3	125.3
	80000	74.1	85.1	78.3	77.4	78.2	78.6	77.4	74.3	68.1	69.9	58.7	60.3	121.8
OVERALL CALCULATED		100.3	102.8	102.4	103.4	106.4	107.3	106.3	103.2	99.4	97.8	93.2	90.8	136.3

Table 9

MODEL SOUND PRESSURE LEVELS (59°F, 70% Relative Humidity, Day)

Angles from Inlet in Degrees (and Radians)

GROUND PLANE, Z/D = 0.90

CORRECTED SPEED = 54%

FREQ.	0. (0.)	10. (0.17)	20. (0.35)	30. (0.52)	40. (0.70)	50. (0.87)	60. (1.05)	70. (1.22)	80. (1.40)	90. (1.57)	100. (1.75)	110. (1.92)	PWL
50													
63													
80													
100	73.6	73.5	72.5	71.4	68.6	69.3	71.3	71.5	70.3	70.0	69.7	68.0	104.0
125	76.1	75.9	75.3	71.6	71.3	70.5	70.8	72.0	70.6	69.5	68.4	69.3	104.4
160	73.3	71.5	72.0	73.4	71.3	70.0	69.0	68.8	67.8	65.5	67.4	66.3	103.0
200	77.8	79.0	76.3	76.9	75.6	75.0	73.0	72.8	71.3	69.3	67.2	66.5	106.9
250	79.5	79.0	76.3	76.4	77.1	75.9	74.2	73.3	72.3	72.7	70.1	68.3	108.1
315	79.8	79.0	77.3	77.6	76.1	74.3	72.5	71.5	69.6	68.5	67.4	66.3	106.6
400	77.5	77.5	76.8	76.8	74.6	73.3	72.0	70.5	68.8	67.7	64.9	62.8	105.6
500	76.0	75.5	75.3	75.1	74.1	73.0	72.0	70.3	68.5	66.9	64.2	61.8	104.7
630	76.8	76.5	76.8	77.8	75.6	74.8	72.3	71.5	69.5	68.4	66.5	63.8	106.3
800	76.3	76.0	75.5	75.6	73.6	73.5	69.5	68.0	66.5	65.4	64.5	61.6	104.3
1000	75.8	74.3	75.5	76.5	74.3	75.2	70.7	68.0	65.7	63.9	62.5	61.2	104.8
1250	77.0	76.8	77.0	76.1	73.8	72.7	71.2	69.0	66.8	66.2	63.3	61.5	104.8
1600	76.8	76.1	74.5	74.6	74.3	74.0	72.0	69.5	66.5	66.1	64.9	61.6	104.6
2000	76.5	76.8	77.0	77.6	76.6	75.7	73.9	71.3	68.5	66.1	64.4	62.7	106.6
2500	78.3	78.1	78.0	78.6	78.0	77.5	76.2	72.8	70.3	67.9	65.4	64.2	108.2
3150	79.8	79.8	80.3	80.4	79.8	80.2	78.9	75.8	72.5	69.6	67.7	66.4	110.6
4000	82.0	82.7	82.7	83.1	82.2	82.6	81.8	78.9	75.5	73.5	70.9	69.6	113.2
5000	85.7	86.2	86.9	87.3	85.6	84.8	83.7	80.1	76.7	73.9	72.7	71.2	116.0
6300	95.3	96.0	96.6	96.0	98.2	96.7	96.5	94.1	91.5	87.4	83.7	82.6	126.1
8000	85.4	85.9	87.1	86.1	87.5	87.2	85.9	83.0	78.8	75.6	73.4	71.4	117.6
10000	86.7	86.1	87.8	86.2	87.8	87.7	86.1	82.3	77.3	73.7	72.3	71.1	118.1
12500	89.3	93.4	94.6	94.0	93.3	93.1	93.0	89.9	84.6	80.5	78.0	78.6	124.6
16000	85.4	85.8	87.2	89.0	87.9	87.1	86.2	83.1	77.2	73.2	71.6	69.2	118.6
20000	86.6	87.6	86.9	91.2	90.7	91.1	90.4	86.6	81.3	77.4	75.2	73.4	122.5
25000	82.6	83.7	86.3	86.0	88.3	90.3	87.6	83.7	78.4	71.6	68.0	66.4	120.7
31500	80.4	81.2	84.0	86.2	85.7	86.0	85.6	81.3	72.7	70.2	64.3	62.5	118.7
40000	77.3	78.4	81.3	83.3	83.1	83.2	81.7	77.7	69.5	66.6	64.4	60.2	117.0
50000	77.3	77.3	79.6	82.3	81.3	81.5	79.7	75.4	67.0	66.7	64.7	60.3	117.2
63000	75.4	76.9	78.7	79.7	79.5	79.5	77.7	72.5	65.1	64.3	64.3	60.9	117.8
80000	72.4	72.1	74.3	74.7	73.7	74.1	73.0	66.0	59.8	58.3	57.3	57.3	116.6
OVERALL CALCULATED	101.9	99.9	101.0	101.8	101.5	101.0	100.3	97.5	93.7	90.0	87.0	85.3	132.6

Table 10

MODEL SOUND PRESSURE LEVELS (59°F, 70% Relative Humidity, Day)

Angles from Inlet in Degrees (and Radians)

GROUND PLANE, Z/D = 0.90

CORRECTED SPEED = 69%

RADIAL 17. FT.
(5. M)
VEHICLE R-11
CONFIG CF 6
LOC SCHENECTADY
DATE 3/31/76
RUN 10/3
TAPE
BAR 29.9 MG
(01106. N/M2)
TAMB 50. DEG F
(283. DEG K)
TAEL 47. DEG F
(281. DEG K)
HACT 7.55 GM/M3
(.00755 KG/M3)
NFA 11023. RPM
(1154. RAD/SEC)
NFK 11120. RPM
(1164. RAD/SEC)
NFC 16100. RPM
(1686. RAD/SEC)
NO. OF BLADES 44
FAN TIP SPEED
955. FT/SEC

FREQ.	0. (0.)	10. (0.17)	20. (0.35)	30. (0.52)	40. (0.70)	50. (0.87)	60. (1.05)	70. (1.22)	80. (1.40)	90. (1.57)	100. (1.75)	110. (1.92)	PWL
50													
63													
80													
100	75.6	75.3	74.8	73.4	70.8	71.3	73.5	74.3	73.4	73.3	72.0	70.4	106.5
125	77.1	76.3	75.0	72.9	72.3	71.8	71.5	72.5	71.4	71.1	69.0	66.9	105.3
160	75.3	74.3	74.5	73.6	73.6	72.3	71.5	70.5	69.7	72.1	69.6	69.4	105.5
200	79.6	80.6	80.3	78.6	77.6	76.5	75.2	74.5	72.7	72.3	70.0	71.3	108.9
250	82.5	81.8	81.0	81.4	80.1	77.8	77.0	75.5	74.7	75.3	72.0	69.6	110.7
315	83.6	83.0	81.5	81.6	79.8	78.0	76.2	75.0	72.7	73.3	70.0	69.3	110.4
400	82.3	82.0	80.8	80.0	79.1	77.5	76.0	74.8	72.9	72.0	68.0	66.0	109.6
500	80.3	79.3	79.3	79.6	78.3	76.8	76.0	74.5	72.6	71.3	68.1	65.6	108.9
630	81.6	81.3	81.6	82.6	80.8	78.8	77.7	76.0	74.6	73.0	70.4	66.1	111.1
800	82.3	81.0	81.5	81.5	79.3	76.5	75.5	73.5	71.1	71.0	69.1	66.3	109.6
1000	80.5	79.3	79.5	80.0	79.3	77.0	75.0	72.3	70.1	70.0	67.9	66.3	109.2
1250	80.5	80.8	80.0	79.1	76.6	76.0	75.2	72.8	70.6	73.5	67.2	65.3	108.4
1600	80.5	79.6	78.8	79.1	76.6	76.2	77.2	74.8	71.9	73.5	67.7	65.6	109.3
2000	82.3	81.3	82.5	82.1	80.8	80.5	78.2	76.0	73.1	73.3	69.3	67.0	111.4
2500	82.5	82.1	82.3	83.4	82.0	82.5	80.4	77.3	74.4	72.2	69.6	68.0	112.6
3150	84.0	83.6	84.5	85.6	85.5	85.2	84.4	82.0	78.6	76.4	73.6	72.5	115.8
4000	85.0	85.2	86.4	86.3	86.7	86.1	84.6	82.2	78.3	75.3	73.6	73.6	116.6
5000	86.7	86.9	87.1	86.0	89.1	89.5	86.5	82.9	79.3	76.3	74.3	72.8	118.7
6300	86.3	89.5	90.0	91.5	90.9	93.7	92.5	89.2	84.1	81.5	79.3	76.3	122.9
8000	97.9	99.9	101.1	104.1	104.2	109.0	110.4	106.5	101.4	99.2	97.0	91.7	139.0
10000	89.7	90.3	91.8	90.2	93.3	95.2	95.1	92.3	86.2	84.1	81.9	77.9	125.3
12500	89.6	90.1	91.6	92.7	92.6	92.3	92.0	88.6	83.5	80.6	78.2	75.2	123.3
16000	93.9	94.8	95.2	97.7	96.6	100.3	97.9	96.9	90.3	85.6	82.5	80.3	130.1
20000	88.3	89.7	91.2	92.4	92.5	92.9	91.1	88.6	81.9	78.0	75.3	72.6	123.8
25000	89.4	89.7	93.3	93.0	95.3	95.5	95.3	92.2	85.5	79.9	75.6	74.2	127.5
31500	88.1	88.2	90.5	92.7	93.0	92.5	92.5	89.1	81.6	76.8	71.0	68.8	125.6
40000	84.8	85.4	87.8	89.6	89.6	89.7	89.2	85.9	76.4	73.9	68.3	65.5	123.9
50000	83.8	84.3	86.6	87.6	87.8	88.3	88.2	83.9	77.1	72.1	65.3	65.9	124.2
63000	81.6	81.7	84.0	85.2	85.7	86.8	85.9	82.0	74.9	70.4	63.9	67.2	124.8
80000	76.1	75.8	77.8	78.9	79.5	79.9	80.0	75.3	68.9	63.4	61.1	64.3	122.4
OVERALL CALCULATED	102.3	103.4	104.6	106.9	107.1	110.4	111.2	107.6	102.3	100.0	96.1	92.9	140.8

Table 11

MODEL SOUND PRESSURE LEVELS (59°F, 70% Relative Humidity, Day)

Angles from Inlet in Degrees (and Radians)

GROUND PLANE, Z/D = 0.90

CORRECTED SPEED = 86%

	FREQ.	0. (0.)	10. (0.17)	20. (0.35)	30. (0.52)	40. (0.70)	50. (0.87)	60. (1.05)	70. (1.22)	80. (1.40)	90. (1.57)	100. (1.75)	110. (1.92)	PNL
RADIAL 17. ET.	50													
(5. M)	63													
VEHICLE R-11	80													
CONFIG CF 6	100	70.1	70.0	70.0	69.1	69.5	89.5	71.5	73.0	72.5	75.5	71.5	70.0	113.5
LOC SCHENECTADY	125	72.5	71.5	71.0	66.9	69.5	86.0	70.2	71.5	69.5	74.0	69.5	70.0	110.5
DATE 3/31/76	160	71.8	70.5	70.5	71.1	73.2	85.5	73.2	73.2	70.0	75.5	72.5	72.0	110.7
RUN 10/4	200	77.5	76.8	76.0	77.9	78.0	86.7	75.2	77.2	76.0	79.5	73.5	74.0	113.1
TAPE	250	79.0	79.8	79.5	81.1	80.2	86.5	77.2	79.5	79.5	81.0	76.0	77.0	114.3
BAR 29.9 HG	315	79.0	78.5	77.5	77.5	76.0	89.2	75.0	74.2	85.7	78.0	67.0	69.5	113.0
(01106. N/M2)	400	79.5	79.0	78.0	78.3	76.2	87.5	74.0	73.0	70.2	80.5	67.1	69.0	112.9
TAMB 50. DEG F	500	78.5	77.8	77.5	77.0	76.5	87.0	75.0	74.2	71.2	81.0	66.0	72.0	112.6
(283. DEG K)	630	81.0	80.3	80.0	80.0	79.0	91.2	76.2	77.0	73.2	81.5	69.5	67.5	116.0
TWET 47. DEG F	800	82.0	81.3	80.3	80.8	79.0	87.4	74.5	77.7	70.2	78.7	66.0	69.5	113.4
(281. DEG K)	1000	81.8	80.8	81.0	82.3	81.0	92.9	76.2	78.0	72.2	81.7	72.0	70.0	117.5
	1250	83.5	82.5	82.8	85.0	84.5	93.7	82.2	81.5	75.4	80.0	77.4	75.0	118.9
	1600	83.0	82.1	81.3	83.8	82.0	90.4	80.2	79.3	77.2	77.0	70.2	69.2	116.1
HAUT 7.55 GM/M3	2000	88.0	86.1	85.0	85.6	87.5	92.9	82.7	81.8	79.7	80.9	76.8	75.5	119.0
(.00755 KG/M3)	2500	86.5	87.1	87.5	87.9	92.0	94.2	92.2	90.8	86.0	84.2	82.0	82.5	123.2
NFA 13743. RPM	3150	91.0	90.1	91.0	94.6	91.2	98.9	96.6	100.0	97.7	91.9	90.0	88.4	129.6
(1439. RAD/SEC)	4000	99.2	100.5	101.4	99.8	101.1	107.3	109.1	106.9	105.4	102.5	100.3	97.6	138.9
NFA 13864. RPM	5000	99.2	100.9	100.6	102.0	100.6	108.7	110.2	107.9	105.3	102.7	100.6	97.5	139.3
(1452. RAD/SEC)	6300	96.5	95.5	97.0	97.6	96.3	104.9	106.2	104.4	99.9	98.5	94.0	90.7	135.3
NFD 16100. RPM	8000	97.7	97.6	98.9	100.6	101.9	105.4	106.1	104.5	100.5	96.9	92.5	90.7	135.6
(1686. RAD/SEC)	10000	105.2	106.3	107.3	106.5	109.2	110.1	110.9	109.3	104.5	99.8	96.2	92.4	141.2
NO. OF BLADES 44	12500	96.6	96.9	98.3	100.2	100.5	104.0	104.9	102.6	98.1	93.5	90.4	87.6	134.6
FAN TIP SPEED	16000	95.1	95.3	96.9	99.0	99.8	103.8	102.7	100.6	96.8	91.7	87.7	84.7	133.6
1190. FT/SEC	20000	97.5	97.2	98.7	100.5	100.9	104.4	101.6	100.5	95.5	91.0	86.0	82.4	134.1
	25000	93.0	94.2	95.5	96.8	97.5	102.5	99.1	96.7	92.8	87.9	82.0	78.1	132.0
	31500	93.1	92.5	94.5	96.2	95.9	99.9	97.7	96.1	90.4	86.7	80.0	76.0	131.3
	40000	90.0	90.9	92.0	93.6	93.8	103.7	95.5	93.6	87.9	84.9	78.0	73.9	133.2
	50000	89.5	89.6	90.0	92.0	92.5	101.0	94.5	92.4	86.7	85.5	74.5	74.1	132.9
	63000	87.4	87.2	88.0	89.7	90.1	105.2	92.6	90.7	85.2	83.5	72.0	73.9	136.1
	80000	80.1	79.0	81.0	82.7	84.4	104.1	87.7	85.0	80.2	77.5	70.5	74.0	140.4
OVERALL CALCULATED		109.2	110.0	111.0	114.1	112.6	117.2	116.9	115.4	111.6	108.5	105.0	102.5	148.5

Table 12

MODEL SOUND PRESSURE LEVELS (59°F, 70% Relative Humidity, Day)

Angles from Inlet in Degrees (and Radians)

RADIAL 17. FT.
(5. M)
VEHICLE R-11
CONFIG CF 6
LOC SCHENECTADY
DATE 3/31/76
RUN 10/5
TAPE
BAR 29.9 HG
(01106. N/M2)
TAMB 50. DEG F
(283. DEG K)
TWET 47. DEG F
(281. DEG K)
HACT 7.55 GM/M3
(.00755 KG/M3)
NFA 14372. RPM
(1505. RAD/SEC)
NFK 14498. RPM
(1518. RAD/SEC)
NFD 16100. RPM
(1686. RAD/SEC)
NO. OF BLADES 44
FAN TIP SPEED
1245. FT/SEC

GROUND PLANE, Z/D = 0.90

CORRECTED SPEED = 90%

FREQ.	0. (0.)	10. (0.17)	20. (0.35)	30. (0.52)	40. (0.70)	50. (0.87)	60. (1.05)	70. (1.22)	80. (1.40)	90. (1.57)	100. (1.75)	110. (1.92)	PNL
50													
63													
80													
100	67.0	67.3	67.5	68.9	69.5	70.0	70.2	71.5	71.3	75.0	70.0	66.0	104.9
125	72.0	70.0	70.3	67.1	70.5	70.2	70.2	71.5	69.5	76.0	69.3	70.1	105.0
160	72.1	69.5	69.5	70.4	72.7	72.7	73.5	73.2	70.8	77.8	73.5	73.3	107.3
200	74.0	74.5	73.8	72.8	73.0	72.7	71.7	72.7	72.2	77.8	69.5	67.0	106.8
250	78.0	76.3	76.3	76.4	77.0	75.0	75.5	80.0	83.0	81.5	80.0	75.5	112.9
315	76.5	76.5	75.8	75.6	74.7	73.7	72.2	71.5	69.2	80.3	67.5	66.0	108.1
400	77.5	77.0	76.5	76.0	74.7	74.0	73.0	72.0	69.0	79.0	65.8	64.0	108.0
500	78.5	78.8	78.5	77.0	76.7	77.2	76.5	74.7	74.2	77.8	66.5	65.0	109.1
630	81.0	79.3	79.3	80.3	78.7	77.0	76.0	74.7	72.7	83.8	69.3	66.3	111.6
800	81.8	80.5	80.5	80.8	79.5	78.7	75.5	75.0	70.7	83.5	69.4	66.0	111.6
1000	82.3	80.0	80.5	81.5	80.2	78.4	77.7	76.0	72.7	77.2	71.1	67.3	110.8
1250	85.3	84.1	84.0	83.1	82.5	80.7	81.9	81.2	79.2	83.0	76.4	73.8	114.8
1600	86.8	86.3	84.8	84.8	85.7	86.7	89.4	88.0	85.5	83.7	79.7	80.7	119.7
2000	93.3	90.1	89.0	90.1	100.0	103.9	105.2	103.0	99.5	97.4	93.3	92.2	134.2
2500	87.3	88.1	89.3	91.4	95.7	100.4	102.4	99.5	96.5	94.2	90.1	89.7	131.0
3150	90.5	92.0	93.5	95.1	98.9	102.4	102.1	102.0	97.5	93.4	93.1	90.4	132.4
4000	96.3	97.2	97.9	96.8	106.3	110.3	109.3	105.4	102.6	98.8	97.0	94.3	138.7
5000	96.2	96.2	100.1	101.5	107.0	109.7	109.2	104.1	100.8	98.5	95.5	94.8	138.4
6300	96.5	96.5	97.8	98.0	101.6	106.2	105.2	101.6	96.2	95.2	90.8	90.0	134.8
8000	97.4	97.6	96.9	101.6	101.4	103.9	103.4	99.5	96.0	93.9	88.3	88.2	133.4
10000	107.5	107.1	107.8	106.7	109.8	111.6	109.4	106.5	103.5	98.8	95.2	92.9	140.7
12500	99.8	100.4	100.5	102.2	102.5	105.0	104.9	100.8	97.3	92.0	89.4	88.9	135.0
16000	95.9	96.8	97.7	99.5	100.3	102.5	101.7	98.6	94.8	89.5	86.5	85.7	132.8
20000	97.5	98.0	98.9	101.0	101.4	103.1	101.9	98.7	93.5	89.2	84.3	81.4	133.6
25000	94.9	95.2	96.3	97.8	98.0	100.0	99.8	96.2	91.3	86.9	81.0	78.9	131.4
31500	94.1	93.9	95.0	96.7	96.9	99.2	98.0	94.3	89.2	85.2	78.0	75.3	131.0
40000	91.3	91.1	92.0	93.8	94.3	96.2	95.5	91.4	86.4	83.4	74.8	73.4	129.8
50000	89.5	90.1	90.8	93.0	93.5	95.8	94.7	90.4	85.7	83.3	73.3	73.9	130.5
63000	87.4	87.9	88.5	90.0	91.1	94.0	93.1	88.5	83.7	81.1	71.8	75.7	131.4
80000	80.4	79.8	82.3	83.4	85.4	88.6	87.4	83.5	78.2	73.8	70.6	73.8	129.7
OVERALL CALCULATED	110.4	110.3	111.2	112.6	114.5	117.5	116.7	113.3	109.8	106.5	103.5	101.5	147.1

Table 13

MODEL SOUND PRESSURE LEVELS (59°F, 70% Relative Humidity, Day)

Angles from Inlet in Degrees (and Radians)

		0.	10.	20.	30.	40.	50.	60.	70.	80.	90.	100.	110.	
	FREQ.	(0.)	(0.17)	(0.35)	(0.52)	(0.70)	(0.87)	(1.05)	(1.22)	(1.40)	(1.57)	(1.75)	(1.92)	
	50													
	63													
RADIAL 17. FT.	80													
(5. M)	100	64.0	65.6	65.5	65.1	69.5	70.0	70.7	72.7	73.0	75.3	72.6	71.0	105.5
VEHICLE R=11	125	66.1	66.0	69.3	66.9	69.7	70.0	70.5	72.0	72.3	74.8	73.8	73.3	105.8
CONFIG CF 6	160	72.1	69.8	69.0	69.6	72.2	72.5	73.5	74.5	74.0	76.3	77.0	76.0	108.3
LOC SCHENECTADY	200	65.3	65.3	67.3	67.4	71.0	70.7	70.2	70.8	69.2	75.3	84.3	84.3	103.8
DATE 3/31/76	250	61.6	70.3	61.0	63.4	65.2	64.7	86.2	83.0	69.2	77.6	78.3	73.0	116.5
RUN 10/0	315	74.3	72.8	72.8	74.8	75.5	75.7	76.2	73.5	76.5	75.0	89.3	88.8	107.8
TAPE	400	72.3	71.3	70.5	71.3	71.2	70.5	70.2	70.0	66.7	76.3	85.1	83.8	104.6
BAR 29.8 HG	500	73.8	71.6	72.3	78.8	78.5	74.7	75.7	75.2	72.7	80.3	85.8	78.8	109.4
(101106. N/M2)	630	75.8	74.0	74.5	75.8	75.2	74.0	73.2	72.7	70.0	79.8	86.3	85.8	108.0
TAMB 5C, DEG F	800	78.8	77.5	75.8	78.3	77.5	78.7	77.2	75.5	76.7	81.5	74.4	71.0	111.1
(263. DEG K)	1000	79.5	77.0	77.0	79.5	84.2	84.7	86.7	87.0	87.4	84.0	81.4	78.8	116.2
TWET 47. DEG F	1250	81.8	80.1	84.0	85.1	91.0	91.9	91.7	91.7	87.9	88.2	83.7	82.8	122.7
(281. DEG K)	1600	84.5	85.6	84.0	94.3	96.7	98.4	97.7	96.0	94.5	91.0	91.0	84.5	128.3
HACT 7.55 GM/M3	2000	83.5	86.1	90.8	93.1	98.7	98.9	97.9	96.0	92.9	93.2	90.5	84.5	128.9
(.00755 KG/M3)	2500	88.3	86.6	92.8	92.4	97.0	99.4	98.7	97.3	91.0	91.2	89.3	84.5	128.8
NFA 15971. RPM	3150	85.5	84.6	86.8	86.6	90.2	93.6	90.8	90.5	86.2	87.8	84.3	79.4	122.5
(1672. RAD/SEC)	4000	88.2	89.5	90.4	90.1	92.3	94.8	92.8	89.4	86.4	87.8	80.3	82.1	123.7
NFA 16114. RPM	5000	95.4	95.7	97.4	95.8	98.8	99.5	98.5	91.9	89.8	90.7	84.5	86.8	128.8
(1687. RAD/SEC)	6300	94.8	93.7	95.8	97.3	101.6	101.2	98.5	96.9	94.2	92.8	89.3	87.7	130.7
NFD 16100. RPM	8000	95.2	95.9	95.8	96.9	96.9	98.4	98.1	100.2	95.8	90.9	87.8	86.2	130.1
(1686. RAD/SEC)	10000	102.8	103.1	103.3	104.5	105.2	103.8	104.8	100.3	96.8	92.8	89.9	87.1	135.2
NO. OF BLADES 44	12500	107.8	107.9	109.3	110.5	112.3	110.5	112.2	107.1	103.8	98.3	96.7	92.9	142.3
FAN TIP SPEED	16000	95.8	96.8	98.9	98.8	98.3	98.8	98.7	95.3	92.1	88.8	84.8	82.8	129.9
1383. FT/SEC	20000	98.8	98.5	97.7	99.5	98.9	98.9	99.1	95.7	91.3	88.2	82.8	83.9	130.8
	25000	98.4	97.5	99.8	100.5	100.8	101.8	101.8	97.2	93.3	88.9	83.1	80.8	133.3
	31500	93.9	94.2	95.8	98.5	98.4	97.4	98.7	92.8	88.7	88.7	78.2	75.3	130.8
	40000	91.3	91.4	92.5	94.3	95.1	95.2	95.8	90.9	88.7	82.9	79.1	73.9	129.4
	50000	98.3	98.1	91.3	93.8	93.7	94.2	94.8	89.8	85.5	82.8	73.3	74.8	130.1
	63000	87.8	87.9	89.2	98.7	91.4	92.5	92.1	87.5	83.7	79.1	71.4	75.9	130.7
	80000	88.8	88.3	82.8	83.4	85.4	86.3	86.9	82.8	77.9	73.3	78.8	73.8	128.8
OVERALL CALCULATED		110.3	110.8	111.8	113.8	114.8	113.8	114.5	110.5	106.9	103.7	100.8	97.7	145.5

Table 14

MODEL SOUND PRESSURE LEVELS (59°F, 70% Relative Humidity, Day)

Angles from Inlet in Degrees (and Radians)

GROUND PLANE, Z/D = 0.90

CORRECTED SPEED = 86% (REPEAT)

RADIAL 17. FT. (5. M)
VEHICLE R-11
CONFIG CF 6
LOC SCHENECTADY
DATE 3/31/76
RUN 1077
TAPE
BAR 29.9 HG (01106. N/M2)
TAMB 50. DEG F (283. DEG K)
TREF 47. DEG F (281. DEG K)
HACT 7.55 GM/M3 (.00755 KG/M3)
NFA 13742. RPM (1439. RAD/SEC)
NFK 13863. RPM (1451. RAD/SEC)
NFD 16109. RPM (1686. RAD/SEC)
NO. OF BLADES 44
FAN TIP SPEED 1190. FT/SEC

FREQ.	0. (0.)	10. (0.17)	20. (0.35)	30. (0.52)	40. (0.70)	50. (0.87)	60. (1.05)	70. (1.22)	80. (1.40)	90. (1.57)	100. (1.75)	110. (1.92)	PWL
50													
63													
80													
100	78.6	78.8	78.3	80.9	69.5	78.6	71.5	74.3	72.5	76.6	71.6	69.1	105.6
125	72.3	71.9	71.3	80.6	69.7	78.2	78.5	72.2	69.3	74.6	69.3	78.1	104.6
160	72.1	78.5	78.5	71.6	73.2	73.2	73.2	73.5	78.5	76.6	72.3	72.3	106.9
200	78.3	79.3	78.6	78.6	76.3	78.5	75.3	77.3	78.2	79.6	75.3	75.6	110.6
250	79.6	80.6	80.6	81.4	81.6	78.5	77.3	79.7	79.2	82.3	78.3	78.6	113.4
315	79.3	78.6	77.3	77.3	75.3	74.5	73.2	71.7	69.3	80.3	87.6	86.5	108.7
400	79.3	79.6	78.3	77.8	76.5	75.5	74.5	73.6	78.5	80.6	86.6	85.6	109.0
500	78.6	78.3	77.8	77.8	77.2	76.5	75.5	73.5	71.2	86.6	86.6	84.6	109.6
630	81.6	80.3	80.6	80.1	79.3	78.7	78.5	75.2	73.7	80.6	89.6	86.5	110.6
800	82.6	81.3	80.6	80.3	79.2	75.7	74.5	72.7	78.7	80.7	86.4	85.6	110.3
1000	81.6	80.6	81.5	82.3	81.6	77.9	75.9	74.5	72.2	79.7	72.4	86.6	111.3
1250	82.6	82.1	83.3	86.1	85.6	85.4	84.7	81.6	78.7	85.6	77.4	74.3	116.2
1600	82.6	81.6	81.3	83.6	83.6	83.2	81.4	78.6	78.2	86.6	71.2	78.6	115.1
2000	86.3	85.6	85.3	85.4	86.5	84.2	82.9	81.5	80.2	87.7	77.3	77.6	117.6
2500	88.6	87.3	86.3	87.9	92.2	93.4	92.9	91.6	86.2	86.2	82.6	83.2	123.5
3150	91.6	90.3	90.5	94.6	92.4	96.6	99.1	101.2	96.2	93.1	90.3	86.7	130.2
4000	99.6	101.6	101.2	99.1	100.6	107.1	109.1	106.9	105.1	102.3	100.3	97.6	138.6
5000	100.2	101.2	100.6	101.5	100.6	107.2	110.6	108.9	105.6	102.3	100.6	97.6	139.2
6300	96.3	96.2	97.8	96.6	98.3	103.7	106.5	105.1	100.4	99.6	94.6	91.6	135.5
8000	96.9	97.6	99.1	100.4	101.9	103.4	105.9	104.7	100.5	97.4	91.6	90.7	135.4
10000	105.6	105.6	107.3	106.7	109.6	109.6	111.1	109.3	104.6	99.3	97.4	92.9	141.2
12500	96.6	96.9	96.3	100.2	101.3	101.8	103.9	102.6	97.6	92.6	89.9	86.9	134.6
16000	95.4	95.3	97.2	99.2	100.6	101.5	101.9	100.8	96.1	91.3	88.6	84.3	132.9
20000	97.6	97.5	98.4	100.5	100.9	101.6	101.4	100.7	94.7	90.7	85.6	81.9	133.4
25000	93.9	93.7	95.3	97.6	97.3	97.8	99.1	97.2	92.3	87.4	83.1	77.6	130.6
31500	93.1	93.2	94.5	96.5	95.9	96.9	97.5	96.3	90.2	86.2	80.6	75.3	130.5
40000	90.6	91.9	92.6	93.6	93.3	94.9	95.6	93.4	87.9	85.1	78.3	73.7	129.4
50000	89.3	89.3	91.1	92.5	92.6	93.7	93.7	92.9	86.7	85.3	74.6	73.6	130.2
63000	87.6	86.9	88.2	89.7	90.4	92.6	92.4	91.6	85.2	83.6	72.6	75.4	131.1
80000	80.1	79.3	82.6	84.9	84.2	86.3	87.4	85.3	79.7	75.6	70.6	73.3	129.3
OVERALL CALCULATED	109.2	109.8	111.6	114.2	112.6	114.9	116.6	115.8	111.6	106.9	105.4	102.3	147.6

Table 15

MODEL SOUND PRESSURE LEVELS (59°F, 70% Relative Humidity, Day)

Angles from Inlet in Degrees (and Radians)

		0.	10.	20.	30.	40.	50.	60.	70.	80.	90.	100.	110.	
	FREQ.	(0.)	(0.17)	(0.35)	(0.52)	(0.70)	(0.87)	(1.05)	(1.22)	(1.40)	(1.57)	(1.75)	(1.92)	
	50													
	63					GROUND PLANE, Z/D = 0.90								
RADIAL 17. FT.	80					CORRECTED SPEED - 69% (REPEAT)								PWL
(5. M)	100	75.8	75.5	74.5	73.4	73.8	71.3	73.3	74.0	73.2	72.0	71.0	69.9	106.3
VEHICLE R-11	125	77.3	75.8	74.5	72.6	72.6	72.3	71.5	72.5	71.2	70.1	69.0	69.4	105.2
CONFIG CF 6	160	75.6	74.5	74.6	73.1	74.1	72.6	71.5	70.8	69.7	70.0	69.0	69.4	105.6
LOC SCHENECTADY	200	80.0	81.3	80.5	78.9	77.6	77.0	75.5	75.3	74.9	74.0	73.0	71.1	109.3
DATE 3/31/76	250	82.5	81.0	81.3	81.4	79.8	78.3	77.2	76.0	74.7	75.3	74.0	73.0	110.8
RUN 1078	315	83.3	82.5	81.8	81.3	79.0	79.3	78.0	74.8	74.9	74.0	73.0	72.0	110.4
TAPE	400	82.3	82.0	81.6	80.8	79.1	78.5	78.2	74.8	74.6	72.0	72.0	69.3	110.0
BAR 29.9 HG	500	79.8	79.3	79.0	79.8	78.0	78.8	78.4	74.0	74.1	71.1	69.0	69.1	109.2
(01106. N/M2)	630	81.8	81.3	81.5	82.1	80.8	79.0	77.0	75.5	74.1	74.3	73.1	69.3	110.9
TAMB 50. DEG F	800	81.0	81.3	81.0	81.3	79.6	78.7	75.0	73.0	70.9	71.5	69.9	69.1	109.5
(283. DEG K)	1000	80.3	79.3	79.5	80.5	79.8	77.7	75.5	73.0	70.8	71.0	69.0	67.1	109.2
TAET 47. DEG F	1250	80.8	81.8	80.8	79.8	78.8	78.2	75.0	74.5	70.1	71.3	69.7	65.8	108.4
(281. DEG K)	1600	80.0	80.1	78.8	78.8	78.8	77.7	76.7	74.3	71.8	70.0	67.5	66.5	109.4
HACT 7.55 GM/M3	2000	81.8	81.1	81.8	81.9	80.8	79.7	77.9	76.3	72.8	75.5	69.8	69.3	111.2
(.00755 KG/M3)	2500	82.3	81.8	82.0	83.1	82.0	82.0	80.2	77.0	73.8	72.7	69.8	67.8	112.3
NFA 11025. RPM	3150	83.8	83.8	84.0	85.1	84.3	84.2	82.9	80.5	77.8	74.7	72.3	71.0	114.8
(1154. RAD/SEC)	4000	85.2	85.7	85.9	86.1	86.7	85.8	85.8	83.7	79.1	75.8	74.8	74.4	117.0
NFA 11122. RPM	5000	86.4	86.7	87.1	88.3	88.4	87.8	86.5	83.9	79.5	76.0	74.8	73.3	118.1
(1164. RAD/SEC)	6300	88.5	89.2	90.0	91.3	90.9	92.7	92.7	88.7	84.8	81.8	79.8	78.8	122.8
NFA 16100. RPM	8000	98.7	99.6	100.4	104.1	104.0	109.2	111.2	106.0	101.1	99.0	97.0	91.5	134.2
(1686. RAD/SEC)	10000	90.4	90.3	91.8	93.5	93.3	95.2	95.8	91.8	88.4	83.8	82.4	78.4	125.4
NO. OF BLADES 44	12500	89.8	89.9	91.5	92.7	92.6	92.3	91.7	88.1	83.4	79.8	78.4	74.9	123.2
FAN TIP SPEED	16000	93.4	94.8	95.4	98.2	98.1	100.3	98.2	96.4	90.3	85.8	83.8	80.3	130.1
955. FT/SEC	20000	88.3	89.4	91.4	90.8	92.7	92.9	91.4	88.3	81.4	77.8	75.1	71.4	123.9
	25000	89.8	90.0	93.5	95.3	95.1	95.5	95.3	91.5	84.7	79.9	75.8	73.7	127.4
	31500	87.9	88.4	90.2	92.5	92.7	93.0	92.3	88.3	81.3	76.3	73.7	69.8	125.5
	40000	85.8	85.8	87.5	89.6	89.9	90.2	89.8	85.9	78.1	72.9	69.8	65.5	124.0
	50000	83.3	83.8	86.1	88.0	88.3	89.0	88.0	84.4	76.8	72.3	69.5	66.4	124.5
	63000	81.8	81.9	84.2	85.5	85.7	86.8	85.7	81.5	74.9	70.1	69.8	73.7	124.8
	80000	75.4	75.8	77.8	79.2	79.2	80.1	79.2	75.1	67.9	63.8	61.3	65.1	122.2
OVERALL CALCULATED		102.3	103.2	104.3	107.8	106.8	110.5	111.9	107.1	102.1	99.7	98.1	92.8	141.0

Table 16

MODEL SOUND PRESSURE LEVELS (59°F, 70% Relative Humidity, Day)

RADIAL 17, FT. (5. M)
VEHICLE F-11
CONFIG OF 6
LOC SCHENECTADY
DATE 4/27/76
RUN 14/4
TAPE
BAR 29.6 HG (99983. N/M2)
TAMB 30. DEG F (283. DEG K)
TWET 47. DEG F (281. DEG K)
HACT 7.56 GM/M3 (.00756 KG/M3)
NFA 8620. RPM (903. RAD/SEC)
NFK 8696. RPM (910. RAD/SEC)
NFD 16100. RPM (1686. RAD/SEC)
NO. OF BLADES 44
FAN TIP SPEED 747. FT/SEC

Angles from Inlet in Degrees (and Radians)

GROUND PLANE, Z/D = 1.16

CORRECTED SPEED - 54%

FREQ.	0. (0.)	10. (0.17)	20. (0.35)	30. (0.52)	40. (0.70)	50. (0.87)	60. (1.05)	70. (1.22)	80. (1.40)	90. (1.57)	100. (1.75)	110. (1.92)	PWL
50													
63													
80													
100	74.7	74.3	72.6	70.8	68.1	69.4	71.4	71.5	70.2	70.5	69.7	68.5	104.1
125	75.5	75.8	74.3	71.3	72.8	71.1	70.7	71.8	70.7	69.2	70.7	70.5	105.0
150	72.2	72.0	72.1	72.3	71.1	69.4	68.7	69.6	68.9	66.5	66.4	68.3	103.0
200	77.5	78.8	77.6	75.5	75.0	74.4	72.7	72.5	70.4	69.2	67.4	66.0	106.4
250	79.0	78.8	77.8	77.8	76.3	74.9	72.9	72.0	70.7	71.5	69.4	67.0	107.2
315	79.5	79.3	78.1	77.0	75.8	74.4	72.1	71.0	68.4	67.2	65.9	64.8	106.4
400	76.2	76.5	76.3	75.3	73.8	72.6	70.6	68.8	66.6	66.2	63.4	60.8	104.5
500	73.2	73.8	74.1	73.3	72.3	70.3	68.6	67.3	65.6	64.7	61.7	59.0	102.5
630	75.5	76.0	75.6	75.2	73.1	70.8	68.4	67.0	65.4	65.2	62.7	59.5	103.5
800	73.4	73.5	73.1	72.7	71.3	69.8	67.6	65.3	63.1	63.2	62.2	59.5	101.6
1000	70.4	71.0	71.3	71.2	69.8	68.3	66.1	64.5	61.8	59.7	59.0	58.5	100.0
1250	71.7	72.0	72.6	72.5	71.3	69.8	67.9	66.0	63.4	62.4	60.5	59.0	101.4
1600	72.2	73.6	72.3	72.3	72.5	72.1	69.1	67.0	63.6	62.9	60.1	59.0	102.4
2000	74.5	75.3	74.8	75.3	74.3	74.3	72.1	69.3	65.9	64.4	61.9	61.7	104.7
2500	78.2	78.3	77.6	77.8	77.3	77.0	75.3	72.0	68.9	66.9	64.7	63.4	107.5
3150	80.7	81.1	79.3	79.8	80.0	79.3	77.6	74.0	70.1	68.1	65.7	65.1	109.7
4000	83.1	84.0	83.7	83.0	82.4	82.2	79.7	76.2	72.6	71.0	68.4	67.6	112.6
5000	85.3	85.9	85.9	85.7	85.3	84.6	82.7	78.9	74.8	73.4	71.2	70.5	115.2
6300	95.4	95.2	96.1	97.2	97.9	96.5	95.4	92.6	88.1	87.1	84.0	82.7	127.4
8000	84.1	84.6	86.2	86.8	87.0	87.0	84.3	81.0	76.1	74.1	71.9	71.1	116.8
10000	85.7	85.8	86.9	87.2	87.8	87.8	86.3	82.5	76.2	74.0	71.5	70.8	117.9
12500	94.2	92.6	96.1	94.2	93.8	94.2	94.9	90.9	85.2	81.7	79.0	77.6	125.6
16000	83.8	85.5	87.5	88.4	87.8	87.4	86.1	83.4	76.5	73.4	70.9	69.2	118.6
20000	85.7	87.0	88.5	92.1	92.9	93.2	91.3	89.0	81.9	76.9	74.0	71.7	123.9
25000	82.1	84.0	86.6	87.7	88.3	89.1	88.0	83.9	76.0	71.3	68.0	66.9	120.4
31500	79.8	81.2	84.0	86.1	86.0	86.0	86.2	81.3	73.1	68.2	64.3	63.0	118.9
40000	77.9	78.6	81.5	82.8	83.4	83.6	82.1	78.1	69.6	64.5	60.7	60.1	117.2
50000	76.4	78.0	80.1	81.2	81.8	81.6	80.1	76.1	67.4	63.2	60.6	59.6	117.3
63000	75.6	76.2	78.8	79.4	79.4	79.3	78.1	72.7	66.4	62.0	60.5	60.6	117.8
80000	70.3	70.3	73.6	73.1	73.5	72.9	71.1	66.0	63.1	57.0	57.0	60.0	115.6
OVERALL CALCULATED	99.6	99.4	101.0	101.4	101.7	101.3	100.4	97.1	91.7	89.7	86.9	85.7	132.6

Table 17

MODEL SOUND PRESSURE LEVELS (59°F, 70% Relative Humidity, Day)

Angles from Inlet in Degrees (and Radians)

FREQ.	0. (0.)	10. (0.17)	20. (0.35)	30. (0.52)	40. (0.70)	50. (0.87)	60. (1.05)	70. (1.22)	80. (1.40)	90. (1.57)	100. (1.75)	110. (1.92)	PWL
					GROUND PLANE, Z/D = 1.16								
RADIAL 17. FT.					CORRECTED SPEED = 69%								
(5. M)													
VEHICLE R-11													
CONFIG CF 6													
LOC SCHENECTADY													
DATE 4/27/76													
RUN 14/5													
TAPE													
BAR 29.5 HG													
(99989. N/M2)													
TAMB 50. DEG F													
(283. DEG K)													
TMET 47. DEG F													
(281. DEG K)													
RHO 7.54 GM/M3													
(.00756 KG/M3)													
NFA 11003. RPM													
(1153. RAD/SEC)													
NFK 11105. RPM													
(1153. RAD/SEC)													
NFD 16100. RPM													
(1686. RAD/SEC)													
NO. OF BLADES 44													
FAN TIP SPEED													
953. FT/SEC													
	50												
	63												
	80												
	100	75.4	75.8	74.3	72.9	70.8	71.3	73.5	73.6	73.2	72.6	72.7	71.0	106.4
	125	77.0	76.8	75.0	73.4	74.0	72.0	72.0	72.6	71.7	70.3	71.7	70.5	106.1
	160	76.1	75.0	75.0	76.1	74.3	72.3	71.8	70.3	69.9	69.6	70.2	70.0	105.6
	200	79.5	81.0	79.8	78.4	77.1	76.5	75.0	74.3	72.9	72.1	70.4	72.0	108.9
	250	82.8	82.0	81.3	81.6	80.3	78.0	76.2	75.3	74.4	74.8	73.1	71.0	110.8
	315	83.5	83.5	81.8	81.3	79.8	77.8	76.2	74.3	71.9	70.8	69.2	68.5	110.3
	400	81.3	81.5	80.3	80.3	78.3	77.0	74.5	73.3	71.4	70.1	67.4	65.3	108.9
	500	78.5	78.8	78.3	78.8	77.1	75.3	74.0	71.8	70.4	68.3	66.0	64.0	107.4
	630	79.8	80.0	79.8	80.3	78.1	75.5	73.2	72.0	70.6	69.3	67.5	64.8	108.3
	800	77.8	78.3	77.5	78.0	76.3	74.5	72.7	70.3	67.9	67.5	67.2	65.2	106.6
	1000	74.8	75.5	75.8	76.0	74.3	74.0	73.0	70.3	70.1	67.8	66.2	64.2	105.5
	1250	75.5	75.6	75.0	75.8	74.6	73.7	72.2	69.8	67.9	66.5	64.0	62.5	105.0
	1600	75.8	76.3	76.0	77.3	77.3	76.2	74.0	71.8	69.1	67.5	65.1	64.2	106.9
	2000	78.0	78.8	78.3	79.5	79.6	77.7	75.9	73.3	69.6	68.0	66.4	63.9	108.8
	2500	80.0	80.1	79.8	81.6	80.3	79.7	78.2	75.3	72.4	70.2	67.2	65.9	110.5
	3150	84.3	84.3	83.5	84.6	84.0	84.4	84.1	81.5	78.1	75.4	73.5	71.6	115.2
	4000	86.2	87.0	85.9	86.6	86.7	86.6	85.1	82.2	77.6	76.8	73.4	73.3	116.9
	5000	85.9	86.2	86.4	87.8	86.9	86.5	85.5	82.1	78.3	76.0	73.9	73.0	117.2
	6300	87.3	88.0	88.5	90.0	90.9	91.4	89.2	87.2	82.6	79.8	78.3	76.2	121.1
	8000	97.7	99.4	100.1	103.6	105.7	108.7	104.9	105.0	99.6	96.5	95.7	92.6	137.2
	10000	88.7	89.3	90.1	92.5	92.6	93.4	91.4	90.1	84.4	80.8	80.5	77.6	123.4
	12500	88.6	89.4	90.5	92.5	92.3	92.3	92.0	88.6	83.0	79.3	77.3	75.6	123.1
	16000	93.6	94.3	95.4	98.0	98.9	100.6	98.4	96.9	90.5	86.3	83.4	81.7	130.4
	20000	87.8	89.2	90.7	92.7	92.5	92.4	90.9	88.5	81.9	78.8	74.6	72.2	123.7
	25000	88.6	90.2	92.8	95.0	95.3	96.0	95.8	91.9	86.0	80.7	77.2	74.9	127.9
	31500	87.3	88.4	90.5	93.0	93.2	92.7	93.2	89.6	82.6	76.3	72.1	69.0	126.1
	40000	84.5	85.6	87.5	89.8	89.6	90.2	89.2	86.7	78.6	72.4	67.7	65.1	124.2
	50000	83.0	84.0	86.1	88.3	88.6	89.0	88.0	84.7	77.1	69.6	65.6	63.3	124.6
	63000	80.9	81.4	83.5	85.2	86.7	86.8	85.9	82.5	75.2	67.4	63.3	62.4	125.0
	80000	75.4	75.6	78.0	78.7	79.7	79.9	79.5	75.6	68.9	61.9	58.2	62.6	122.4
OVERALL CALCULATED	101.8	102.9	103.8	106.6	107.9	110.1	107.2	106.4	100.9	97.5	96.5	93.7	139.7	

Table 18

MODEL SOUND PRESSURE LEVELS (59°F, 70% Relative Humidity, Day)

Angles from Inlet in Degrees (and Radians)

GROUND PLANE, Z/D = 1.16

CORRECTED SPEED = 86%

RADIAL 17. FT. (5. M)
VEHICLE R=11
CONFIG CF 6
LOC SCHENECTADY
DATE 4/27/76
RUN 11A
TAPE
BAR 29.6 MG (99989. N/M2)
TAMB 69. DEG F (293. DEG K)
TWET 47. DEG F (281. DEG K)
RHOI 7.86 GM/M3 (.00786 KG/M3)
NFA 13721. RPM (1437. RAD/SEC)
NFK 13655. RPM (1451. RAD/SEC)
NFD 16100. RPM (1686. RAD/SEC)
NO. OF BLADES 44
FAN TIP SPEED 1188. FT/SEC

FREQ.	0. (0.)	10. (0.17)	20. (0.35)	30. (0.52)	40. (0.70)	50. (0.87)	60. (1.05)	70. (1.22)	80. (1.40)	90. (1.57)	100. (1.75)	110. (1.92)	PNL
50													
63													
80													
100	70.6	70.3	69.6	68.4	70.0	70.7	71.7	72.2	72.5	72.6	71.0	69.1	104.8
125	71.8	71.8	71.0	67.6	71.7	70.7	70.7	70.5	69.0	68.0	69.6	69.8	103.7
160	70.8	69.8	69.5	70.4	71.5	71.2	71.0	70.7	69.0	70.5	72.3	71.6	104.6
200	77.8	79.3	78.3	78.4	78.0	76.2	76.0	77.0	75.2	76.8	71.0	75.0	110.0
250	79.5	80.5	79.8	81.1	79.7	78.0	78.0	78.7	77.7	79.3	72.6	77.6	112.1
315	78.5	78.3	76.8	76.8	75.5	73.7	73.0	71.2	68.2	67.5	66.5	65.0	106.1
400	78.0	77.5	76.0	76.6	75.0	74.7	72.7	71.7	68.5	68.0	66.1	64.5	106.0
500	75.8	76.5	76.0	76.6	74.7	74.0	72.5	71.0	68.0	66.3	63.6	63.0	105.5
630	80.3	78.8	78.0	77.8	76.2	74.5	72.2	72.7	70.5	69.0	65.6	64.0	106.9
800	75.8	75.8	75.8	76.5	75.5	74.2	72.7	71.5	68.2	68.2	67.4	65.0	105.9
1000	78.5	77.3	77.5	77.5	76.7	74.9	74.4	73.7	71.4	72.2	71.1	69.0	107.7
1250	83.3	81.6	78.8	79.3	83.0	83.2	82.2	80.2	76.9	76.0	74.7	72.3	113.4
1600	82.0	81.8	79.3	79.8	81.5	82.2	80.2	79.8	75.2	73.2	74.0	70.0	112.3
2000	86.3	86.6	86.0	85.1	84.5	83.4	87.4	81.0	81.2	77.7	77.3	75.0	116.6
2500	86.0	84.3	83.5	86.4	91.2	93.9	97.2	93.0	89.0	88.4	84.5	83.9	125.2
3150	88.6	89.1	86.5	89.9	91.2	97.1	99.1	99.7	97.2	94.9	91.3	88.7	129.6
4000	99.2	98.5	95.4	100.1	99.6	107.8	111.0	109.7	106.1	102.0	103.3	97.8	139.9
5000	98.7	98.2	96.4	101.3	100.3	108.2	111.7	110.3	107.8	104.4	103.3	98.0	140.6
6300	95.0	94.2	97.3	99.0	98.3	104.1	107.2	105.4	100.4	98.2	94.6	91.0	135.8
8000	95.9	96.9	98.3	100.3	99.4	105.4	106.1	103.7	99.2	96.1	92.3	90.1	135.4
10000	104.5	105.5	106.8	108.7	107.7	108.6	110.8	108.0	104.0	99.0	96.6	93.6	140.5
12500	95.5	96.6	97.7	100.2	100.2	101.5	104.7	102.6	98.5	94.2	90.6	87.8	134.2
16000	95.1	95.2	96.4	98.7	99.2	100.2	102.4	100.5	95.5	91.7	87.4	84.2	132.6
20000	96.5	97.2	97.9	100.2	99.3	101.3	102.1	99.9	94.7	89.9	85.5	82.9	133.1
25000	92.8	93.6	94.7	96.9	96.7	97.9	99.0	97.1	92.0	86.0	81.5	79.1	130.6
31500	93.0	93.1	94.4	96.4	95.6	97.1	98.1	95.7	90.1	84.4	79.6	75.9	130.5
40000	90.6	90.5	91.6	93.7	93.4	94.6	95.8	93.7	87.6	81.7	75.7	72.8	129.6
50000	88.9	89.4	90.6	92.1	92.1	93.5	94.5	92.2	86.0	79.8	74.3	72.9	130.1
63000	86.8	86.9	88.7	89.4	90.1	91.7	92.8	91.1	84.7	77.8	72.8	73.6	131.0
80000	79.8	79.7	81.9	82.3	84.3	86.0	87.9	85.4	79.4	72.0	71.0	72.4	129.4
OVERALL CALCULATED	108.4	109.0	109.9	112.1	111.4	115.1	117.7	115.9	112.3	108.6	107.5	102.9	147.4

Table 19

MODEL SOUND PRESSURE LEVELS (59°F, 70% Relative Humidity, Day)

Angles from Inlet in Degrees (and Radians)

GROUND PLANE, Z/D = 1.16

CORRECTED SPEED = 90%

RADIAL 17. FT. (5. M)
VEHICLE R-11
CONFIG DF 6
LOC SCHENECTADY
DATE 4/27/76
RUN 14/7
TAPE
BAR 29.6 HG (99989. N/M2)
TAMB 60. DEG F (283. DEG K)
TWET 47. DEG F (281. DEG K)
HAC1 7.56 GM/M3 (.00756 KG/M3)
NFA 14371. RPM (1505. RAD/SEC)
NFA 14497. RPM (1518. RAD/SEC)
NFD 16100. RPM (1686. RAD/SEC)
NO. OF BLADES 44
FAN TIP SPEED 1245. FT/SEC

FREQ.	0. (0.)	10. (0.17)	20. (0.35)	30. (0.52)	40. (0.70)	50. (0.87)	60. (1.05)	70. (1.22)	80. (1.40)	90. (1.57)	100. (1.75)	110. (1.92)	PWL
50													
63													
80													
100	67.1	67.3	66.8	66.6	70.0	70.7	70.7	71.5	71.3	71.0	70.0	69.3	104.0
125	69.1	70.0	70.5	65.1	71.2	70.7	70.7	70.5	68.5	68.3	70.0	70.3	103.5
160	69.8	69.3	68.8	69.1	70.7	70.7	70.7	71.5	70.3	71.0	73.5	73.1	105.1
200	73.0	74.3	73.3	71.6	72.0	71.7	71.5	72.2	70.7	69.5	69.3	67.5	104.6
250	73.3	77.3	78.8	77.1	75.5	74.5	75.7	80.5	81.0	79.5	79.3	74.0	112.0
315	76.3	75.3	74.0	74.1	73.5	72.0	71.5	70.5	67.5	67.0	66.0	64.8	104.3
400	75.0	75.3	74.3	74.8	73.5	73.5	71.7	70.5	67.7	67.3	65.3	68.8	104.8
500	74.8	77.3	76.5	76.6	77.0	77.5	76.0	73.5	70.5	65.5	63.3	69.0	107.6
630	77.0	76.5	75.8	75.6	75.0	72.7	71.2	70.5	67.2	67.0	64.6	72.5	105.5
800	74.8	74.0	73.8	75.0	75.2	73.7	72.7	70.7	67.7	68.7	67.6	72.3	105.7
1000	78.5	75.8	74.5	77.3	75.5	77.2	76.4	74.2	72.4	73.0	70.9	74.5	108.4
1250	83.5	82.6	81.5	82.1	82.7	83.4	83.7	82.7	81.7	81.0	77.9	77.3	115.4
1600	83.8	84.8	85.3	84.8	84.2	90.4	91.7	89.3	87.0	82.5	82.7	82.2	121.0
2000	87.5	92.3	90.8	94.4	97.7	102.9	103.9	103.5	100.0	95.7	93.5	93.7	133.7
2500	88.3	86.6	86.8	89.4	96.0	100.4	102.4	100.8	97.0	95.2	92.6	90.0	131.5
3150	87.3	88.3	91.5	95.9	97.7	103.1	102.1	100.2	96.7	92.4	91.6	92.7	132.1
4000	97.7	97.2	96.2	101.3	104.6	110.8	111.1	107.4	104.6	100.3	99.0	95.8	139.9
5000	99.4	97.9	99.6	102.0	102.3	110.7	111.7	108.6	104.3	102.0	99.8	96.6	140.3
6300	94.8	95.5	97.3	100.0	97.8	104.7	106.5	103.6	98.4	96.7	93.3	92.5	135.1
8000	95.4	96.1	97.6	101.1	99.7	101.9	103.4	100.2	95.0	91.9	89.8	86.9	132.7
10000	106.7	105.6	107.3	108.5	108.5	108.9	109.9	105.5	102.5	97.0	94.4	92.6	139.9
12500	98.3	98.6	100.3	101.7	102.8	103.5	104.2	101.6	97.6	93.3	89.9	87.1	134.6
16000	95.1	96.0	97.7	99.5	99.5	100.5	102.7	99.1	95.3	89.7	87.0	83.7	132.5
20000	96.8	97.7	98.7	100.7	100.9	101.1	101.6	98.0	93.2	87.5	83.8	81.7	132.8
25000	93.9	94.7	95.8	97.5	97.8	98.7	99.5	96.2	90.8	85.4	80.4	77.9	131.0
31500	93.1	92.9	94.7	97.0	96.4	97.4	98.0	94.0	88.2	82.5	77.7	74.6	130.4
40000	89.7	90.8	91.7	93.8	94.0	94.9	95.4	92.1	85.9	79.9	73.6	71.7	129.3
50000	89.8	89.3	90.8	92.3	92.5	94.2	94.2	90.6	84.4	77.7	72.3	72.6	129.9
63000	86.4	86.9	88.7	89.7	90.6	92.0	92.6	89.2	83.2	75.1	70.9	73.4	130.7
80000	79.1	79.6	81.8	82.4	84.7	86.3	87.7	84.0	77.7	70.8	71.1	72.8	129.1
OVERALL CALCULATED	109.6	109.7	110.7	112.6	113.1	115.8	117.7	114.5	110.8	107.1	105.0	102.9	147.3

Table 20

MODEL SOUND PRESSURE LEVELS (59°F, 70% Relative Humidity, Day)

Angles from Inlet in Degrees (and Radians)

GROUND PLANE, Z/D = 1.16

CORRECTED SPEED - 100%

RADIAL 17. FT. (5. M)
VEHICLE R-11
CONFIG CF 6
LOC SCHENECTADY
DATE 4/27/76
RUN 14/M
TAPE
BAR 29.6 HG (99989. N/M2)
TAMB 50. DEG F (283. DEG K)
TWET 47. DEG F (281. DEG K)
HAC! 7.56 GM/M3 (.00756 KG/M3)
NFA 15969. RPM (1672. RAD/SEC)
NFK 16109. RPM (1687. RAD/SEC)
NFD 15100. RPM (1586. RAD/SEC)
NO. OF BLADES 44
FAN TIP SPEED 1383. FT/SEC

FREQ.	0. (0.)	10. (0.17)	20. (0.35)	30. (0.52)	40. (0.70)	50. (0.87)	60. (1.05)	70. (1.22)	80. (1.40)	90. (1.57)	100. (1.75)	110. (1.92)	-PWL
50													
63													
80													
100	64.6	64.3	65.5	64.4	70.0	70.7	71.0	72.2	72.0	72.0	71.5	71.1	104.6
125	65.8	68.8	69.3	63.4	70.2	70.7	70.7	71.5	71.5	71.0	73.3	73.1	105.1
150	71.8	69.8	66.5	68.6	70.7	71.2	71.5	73.5	73.8	75.0	70.5	76.1	107.5
200	66.3	67.0	67.3	66.6	70.5	70.7	70.7	70.5	65.7	64.0	63.6	65.8	101.6
250	80.5	85.0	86.5	87.1	89.0	86.0	86.0	81.2	86.2	77.6	76.0	81.8	118.3
315	72.0	74.5	75.5	76.3	77.5	75.5	75.5	72.0	74.7	70.3	68.5	70.6	107.7
400	68.8	68.5	68.3	69.6	70.2	70.7	70.7	70.5	65.7	66.3	65.1	64.0	102.2
500	69.5	68.5	74.3	78.3	76.5	73.7	75.5	75.7	68.2	73.0	64.3	69.5	107.4
630	71.3	70.8	71.0	72.1	71.5	70.7	70.7	70.5	66.2	66.0	63.3	64.0	102.7
800	73.3	72.3	71.3	72.3	73.0	76.4	76.5	76.5	76.4	74.7	72.4	69.0	108.3
1000	75.0	73.3	70.8	76.8	82.7	87.2	88.4	88.0	86.9	78.7	81.4	76.5	118.5
1250	77.8	79.1	77.0	85.6	93.5	93.9	94.2	93.2	88.9	87.5	82.9	83.6	124.3
1600	82.8	86.8	88.8	96.3	97.2	94.9	96.7	93.8	90.0	88.0	90.2	89.0	127.1
2000	82.5	85.3	87.5	94.6	95.0	97.9	97.7	95.3	93.7	92.2	90.6	88.5	128.2
2500	84.0	85.6	90.0	88.4	95.7	100.2	99.9	98.3	92.0	90.9	86.6	82.5	129.3
3150	84.3	84.1	86.8	86.5	91.9	94.4	92.6	91.7	87.0	84.1	82.3	81.4	123.4
4000	89.5	88.7	88.9	89.6	91.8	94.1	94.1	89.4	84.6	83.0	82.5	81.3	123.5
5000	94.7	94.4	93.9	97.0	97.5	100.5	100.2	96.6	93.6	89.7	86.5	89.8	130.0
6300	93.0	93.7	94.0	95.8	101.3	101.2	100.0	98.6	94.2	91.2	89.1	87.0	131.0
8000	92.4	93.6	94.4	95.6	96.7	98.2	99.1	98.5	93.2	89.9	87.6	85.7	129.4
10000	100.5	101.1	102.6	103.7	103.2	102.6	104.4	100.8	97.0	93.8	90.9	87.4	134.6
12500	106.3	107.6	108.8	110.0	109.5	109.3	111.4	107.3	104.1	100.3	97.4	93.6	141.4
16000	94.1	95.0	95.7	97.2	98.0	98.0	98.7	96.6	92.1	87.7	83.5	81.5	129.6
20000	95.0	95.7	97.2	96.5	98.4	98.1	98.6	96.2	91.7	87.0	82.6	79.9	130.4
25000	96.6	97.5	98.0	99.5	99.5	100.0	101.3	97.7	93.8	88.6	83.6	80.4	132.8
31500	92.6	93.7	94.2	96.0	95.9	96.4	96.5	93.3	88.7	83.7	77.9	74.8	129.6
40000	90.0	91.1	92.2	93.3	93.8	94.4	94.9	91.4	86.7	81.1	74.8	72.7	129.0
50000	89.0	89.8	91.1	92.3	92.7	93.5	93.7	90.9	85.4	79.7	73.0	72.4	129.7
63000	86.1	87.2	88.2	90.0	90.4	91.2	91.9	88.0	84.0	76.3	71.4	73.4	130.2
80000	79.4	79.8	81.5	82.2	84.7	85.8	86.7	83.0	77.9	71.1	71.1	72.5	128.5
OVERALL CALCULATED	104.9	109.9	111.0	112.5	112.7	112.9	114.2	110.9	107.2	103.7	101.2	98.8	144.9

Table 21

MODEL SOUND PRESSURE LEVELS (59°F, 70% Relative Humidity, Day)

Angles from Inlet in Degrees (and Radians)

		0.	10.	20.	30.	40.	50.	60.	70.	80.	90.	100.	110.	
	FREQ.	(0.)	(0.17)	(0.35)	(0.52)	(0.70)	(0.87)	(1.05)	(1.22)	(1.40)	(1.57)	(1.75)	(1.92)	PWL
	BPF	GROUND PLANE, Z/D = 1.16												
RADIAL 17. FT.		CORRECTED SPEED = 86% (REPEAT)												
(5.2 M)	100	70.8	71.0	70.3	69.1	70.0	70.7	71.5	72.2	72.0	72.3	71.0	69.3	104.8
VEHICLE R-11	125	72.1	71.5	71.5	67.6	72.0	70.7	70.7	71.0	68.5	68.3	69.8	70.3	103.8
CONFIG CF 6	150	71.3	70.5	69.9	71.1	71.5	71.7	71.7	71.5	70.0	71.3	72.5	72.1	105.1
LOC SCHENECTADY	200	77.3	79.8	78.8	78.9	79.0	77.7	76.2	77.5	76.2	78.0	74.0	76.3	113.9
DATE 4/27/76	250	78.3	80.5	80.0	81.4	80.5	79.2	78.0	79.7	78.7	81.0	76.3	78.5	113.0
RUN 14/9	315	74.5	78.8	77.0	76.8	75.5	74.2	73.0	71.7	68.5	67.8	66.3	65.8	105.3
TAPE	400	78.3	77.6	77.0	76.8	75.0	74.2	73.0	71.5	68.7	68.3	66.5	64.5	106.1
BAR 29.6 HG	500	75.8	76.3	76.5	76.8	75.0	74.5	73.0	71.2	68.2	67.0	65.1	63.3	105.9
(99969. N/M2)	630	79.5	78.3	77.5	78.1	75.7	73.7	72.5	73.2	70.2	68.8	65.8	64.3	106.7
TAMB 59. DEG F	800	79.5	75.8	76.0	76.3	75.5	74.2	73.0	71.2	67.9	68.0	66.6	64.8	105.8
(293. DEG K)	1000	78.5	77.5	77.8	77.5	76.5	75.7	75.2	74.5	71.4	72.2	71.1	67.8	108.0
TAFT 47. DEG F	1250	82.8	81.3	78.3	79.1	82.5	83.7	82.9	80.5	77.4	76.5	74.7	72.5	113.6
(281. DEG K)	1600	82.3	81.8	79.3	80.1	82.2	82.7	80.7	80.5	75.2	73.2	73.5	69.5	112.7
RHO 7.56 GM/M3	2000	85.8	86.5	86.8	84.9	83.7	82.4	85.9	81.8	80.7	85.9	75.8	74.2	117.0
(.00755 KG/M3)	2500	86.5	84.1	83.5	86.1	91.2	93.9	96.7	93.0	89.5	87.9	84.1	83.7	125.0
NFA 11722. RPM	3150	88.8	89.1	86.3	89.9	90.9	97.4	99.6	100.0	97.7	94.9	91.6	88.4	129.9
(1437. RAD/SEC)	4000	97.5	98.5	96.2	98.3	99.1	108.1	111.6	109.7	106.1	102.0	102.8	97.6	140.1
NFK 13843. RPM	5000	99.4	97.7	98.6	100.6	99.5	107.5	111.7	110.6	107.8	103.7	102.8	97.0	140.7
(1449. RAD/SEC)	6300	95.6	94.2	97.5	98.6	97.6	103.7	107.7	105.9	100.9	98.2	94.8	90.7	136.1
NFD 16100. RPM	8000	95.7	97.1	98.9	100.6	100.2	104.9	106.9	104.0	100.2	96.7	93.3	91.4	135.8
(1686. RAD/SEC)	10000	104.2	106.1	107.1	108.7	107.7	108.9	111.1	108.0	104.0	98.8	96.4	93.9	140.6
NO. OF BLADES 44	12500	99.0	96.9	98.5	99.7	100.3	100.8	105.7	102.6	97.8	93.8	90.2	88.1	134.4
FAN TIP SPEED	16000	94.6	95.5	97.4	99.0	99.3	100.5	102.9	100.8	95.6	91.0	86.7	84.0	132.9
1184. FT/SEC	20000	96.3	97.2	98.4	99.7	99.9	100.8	102.6	99.7	94.5	89.7	84.8	81.9	133.1
	25000	93.1	94.0	95.3	97.0	96.5	97.5	99.5	97.2	91.8	85.6	81.9	78.4	130.7
	31500	92.3	93.4	94.7	96.5	95.7	97.2	99.0	96.3	89.7	84.2	79.2	76.3	131.0
	40000	91.2	91.1	92.2	93.8	93.5	94.7	96.2	93.6	87.2	81.6	75.3	73.2	129.7
	50000	89.3	89.5	90.8	92.0	91.7	93.5	95.5	92.1	86.7	80.2	73.8	72.4	130.3
	63000	86.6	87.2	88.5	89.5	90.1	91.7	93.6	90.5	85.0	77.1	72.6	73.4	131.2
	80000	79.5	79.3	82.0	82.4	84.4	85.6	88.4	85.3	79.2	71.8	71.1	72.3	129.5
	OVERALL CALCULATED	108.3	109.3	110.3	111.9	111.4	115.0	118.1	116.3	112.4	108.3	107.1	102.0	147.5

Table 22

MODEL SOUND PRESSURE LEVELS (59°F, 70% Relative Humidity, Day)

Angles from Inlet in Degrees (and Radians)

GROUND PLANE, Z/D = 1.16

CORRECTED SPEED = 69% (REPEAT)

RADIAL 17. FT. (5. M)
VEHICLE R-11
CONFIG OF 9
LOC SCHENECTADY
DATE 4/27/76
RUN 14/10
TAPE
BAR 29.6 HG (99989. N/M2)
TAMB 50. DEG F (283. DEG K)
TDET 47. DEG F (281. DEG K)
HACT 7.56 GM/M3 (.00756 KG/M3)
NFA 11013. RPM (1153. RAD/SEC)
NFK 11110. RPM (1163. RAD/SEC)
NFD 16100. RPM (1686. RAD/SEC)
NO. OF BLADES 44
FAN TIP SPEED 954. FT/SEC

FREQ.	1. (0.)	10. (0.17)	20. (0.35)	30. (0.52)	40. (0.70)	50. (0.87)	60. (1.05)	70. (1.22)	80. (1.40)	90. (1.57)	100. (1.75)	110. (1.92)	PWL
50													
63													
80													
100	80.1	75.6	74.8	73.4	70.8	71.5	73.5	73.8	73.4	73.1	72.3	70.9	106.6
125	79.6	77.3	75.3	73.6	73.8	72.8	71.8	72.5	71.7	70.3	70.8	70.1	106.0
160	79.3	75.0	75.0	76.9	74.3	72.8	71.8	70.8	70.2	69.6	70.3	69.6	105.9
200	83.8	81.4	80.5	79.4	77.3	77.8	75.5	75.0	72.9	72.3	70.8	71.3	109.5
250	85.3	82.0	81.3	81.6	79.8	78.3	76.0	74.6	73.9	74.3	72.5	70.1	110.6
315	85.0	83.5	82.0	81.6	79.8	78.0	76.2	74.0	71.9	70.3	68.3	67.6	110.3
400	85.5	81.6	80.6	80.3	78.6	77.3	74.7	73.5	71.9	70.3	67.1	65.1	109.2
500	84.5	79.0	79.0	78.8	76.6	75.3	73.5	72.3	70.1	68.3	65.6	63.8	107.5
630	82.0	80.3	80.0	80.1	78.1	75.5	73.5	72.0	70.9	69.3	66.9	64.1	108.4
800	82.0	78.0	77.5	77.8	76.1	75.0	72.5	70.3	68.4	67.5	66.9	64.6	106.8
1000	82.0	78.5	78.5	78.5	74.8	74.7	73.0	70.5	70.3	67.5	65.6	64.3	106.0
1250	80.8	78.6	78.5	78.6	74.3	73.7	72.2	70.0	68.1	66.3	63.2	61.8	105.6
1600	80.3	78.6	78.5	77.3	77.6	76.7	74.5	72.0	70.1	67.8	65.2	64.8	107.6
2000	80.0	78.8	78.0	79.6	78.6	77.0	74.9	72.5	69.6	67.2	65.3	63.5	108.6
2500	80.5	80.3	79.8	81.4	80.0	79.7	78.2	75.3	72.1	69.5	66.8	66.0	110.6
3150	82.3	84.3	83.3	84.4	83.5	83.4	83.1	80.0	76.9	74.2	72.3	70.2	114.5
4000	82.0	86.5	86.2	86.6	86.9	86.8	84.3	81.2	77.1	75.6	72.3	72.9	116.8
5000	82.2	85.9	85.9	87.3	86.6	86.0	85.0	81.9	78.0	75.8	73.0	72.3	116.5
6300	83.0	88.0	89.3	90.0	90.4	91.2	89.7	86.7	82.1	79.8	77.3	76.0	121.0
8000	92.9	99.1	99.9	103.6	106.0	108.5	106.4	103.5	98.6	97.0	94.6	92.2	137.2
10000	96.5	89.1	90.1	92.0	92.6	93.4	91.4	89.3	83.9	81.6	78.9	77.4	123.2
12500	94.8	89.4	90.5	92.2	91.8	92.3	91.5	87.6	82.7	78.6	76.7	74.9	122.8
15000	96.9	94.5	95.7	97.7	98.4	100.3	98.4	96.1	90.5	85.5	83.5	81.6	130.2
20000	95.5	88.7	90.7	92.2	92.2	91.9	90.9	87.5	81.2	76.8	73.1	71.2	123.3
25000	95.1	89.7	93.0	95.5	95.1	95.8	95.6	91.7	85.7	79.9	76.1	74.2	127.8
31500	93.1	88.2	90.5	93.2	93.2	92.9	92.5	88.3	81.8	75.0	71.2	68.8	125.8
40000	92.5	85.3	87.5	89.6	90.1	90.5	89.5	85.2	78.6	71.9	66.3	65.5	124.2
50000	91.3	83.5	86.1	88.8	88.1	88.7	87.7	84.2	76.4	69.5	65.0	64.2	124.5
63000	94.1	81.7	84.0	87.0	86.0	86.8	86.2	81.5	74.9	66.9	63.6	64.7	125.3
80000	94.9	75.6	78.0	81.2	79.2	80.1	79.5	74.3	68.6	61.4	61.3	65.1	123.4
OVERALL CALCULATED	107.3	102.8	103.8	106.5	107.9	109.9	108.1	105.1	100.1	97.9	95.5	93.3	139.7

Table 23

MODEL SOUND PRESSURE LEVELS (59°F, 70% Relative Humidity, Day)

Angles from Inlet in Degrees (and Radians)

FREQ	0. (0.)	10. (0.17)	20. (0.35)	30. (0.52)	40. (0.70)	50. (0.87)	60. (1.05)	70. (1.22)	80. (1.40)	90. (1.57)	100. (1.75)	110. (1.92)	PWL
					NON-POROUS CHAMBER (DOORS TO FILTER HOUSE OPEN) CORRECTED SPEED = 54%								
RADIAL 12 PT													
(5. M)	100	74.3	74.8	69.8	67.6	66.3	66.5	68.9	69.3	67.8	58.8	60.4	60.4	101.9
VEHICLE R-11	125	77.7	77.0	75.3	72.3	71.6	72.1	73.7	73.3	72.8	73.0	71.4	69.8	106.5
CONFIG OF 6	150	71.3	71.3	67.1	67.8	69.1	66.5	67.7	72.3	71.1	66.2	71.2	72.	103.8
LOC SCHENECTADY	200	74.7	75.3	74.3	72.1	70.6	70.9	69.7	69.3	67.3	65.5	64.2	63.5	103.2
DATE 7/1/75	250	79.7	78.3	78.6	77.5	75.3	74.4	72.9	71.3	70.3	70.2	68.9	66.3	107.0
RUN 20/1	315	79.3	79.3	78.8	78.1	76.6	74.9	73.2	72.3	69.6	68.7	67.7	66.3	107.4
TAPE	400	75.1	75.2	74.8	73.3	71.6	70.4	69.2	67.5	65.6	64.7	61.9	60.0	102.9
BAR 29.5 IN	500	74.0	72.3	71.0	70.3	69.8	69.4	67.9	66.5	65.0	63.7	61.7	59.3	101.2
(99895. N/M2)	630	76.7	74.3	74.1	72.8	71.6	71.4	69.4	67.0	65.3	64.7	63.1	61.3	102.5
TAMB 61. DEG F	800	73.9	73.5	73.0	72.7	71.1	70.3	68.1	66.0	64.3	64.4	63.2	61.2	102.2
(300. DEG K)	1000	73.9	71.3	70.8	70.7	69.6	68.8	67.5	64.3	62.0	60.2	59.5	58.2	100.1
TWET 75. DEG F	1250	71.3	72.1	72.3	71.5	70.5	69.1	66.9	64.8	62.0	60.4	59.1	57.5	100.8
(297. DEG K)	1500	72.7	73.1	72.9	71.8	70.6	70.1	68.4	65.6	63.3	61.7	58.9	57.5	101.4
HAST19.80 GM/M3	2000	74.7	75.8	75.1	73.1	73.8	73.1	71.4	68.3	66.1	63.9	61.2	60.7	104.3
(.01980 KG/M3)	2500	78.3	78.3	77.4	76.8	76.5	75.6	74.1	70.8	68.1	66.1	63.4	62.2	106.8
NFA 8877. RPM	3150	80.3	80.3	79.1	79.1	78.7	79.3	77.5	74.3	71.3	68.3	66.3	65.4	109.6
(929. RAD/SEC)	4000	81.9	82.5	81.7	82.3	81.7	81.9	81.5	78.4	74.5	72.5	69.7	68.8	112.7
NFK 8695. RPM	5100	83.8	84.9	85.2	85.1	84.1	83.4	81.4	78.1	75.9	71.9	70.2	69.2	114.3
(910. RAD/SEC)	5150	94.9	94.4	95.6	95.7	96.1	95.3	94.3	92.4	88.2	85.1	81.9	81.9	126.3
NFD 15130. RPM	8000	84.7	85.3	87.3	87.3	86.9	87.3	84.2	81.7	78.7	75.0	72.3	71.1	117.2
(1586. RAD/SEC)	10000	84.5	85.7	86.3	87.3	87.4	87.1	85.4	81.9	78.2	73.3	71.6	70.2	117.5
NO. OF BLADES 44	12500	95.2	95.4	95.3	95.4	95.5	92.9	92.9	90.1	84.9	80.7	78.3	77.4	124.6
FAN TIP SPEED	15000	86.1	85.1	87.8	87.8	86.7	87.3	85.2	83.0	78.3	72.9	70.5	69.9	118.2
769. FT/SEC	20000	93.3	93.4	97.9	98.3	98.6	98.5	98.0	97.4	89.0	75.6	72.6	70.3	122.5
	25000	93.9	91.9	93.3	95.1	95.2	97.5	97.5	93.1	79.5	59.9	60.7	64.5	119.3
	31500	75.9	78.3	81.6	83.3	83.3	83.2	82.3	78.7	70.8	65.5	61.7	59.9	116.1
	40000	72.9	74.3	77.3	77.0	79.1	79.1	78.1	74.4	69.7	51.0	58.2	58.1	113.2
	50000	69.8	71.1	74.5	75.6	75.9	75.9	74.5	70.8	62.6	59.3	57.8	58.4	111.8
	63000	67.2	67.9	70.5	71.3	71.9	72.2	70.2	66.1	59.9	59.1	58.1	59.6	110.5
	80000	61.3	61.4	64.4	64.3	64.1	64.3	63.2	59.9	56.1	54.5	54.6	60.9	107.9
OVERALL CALCULATED		99.4	99.5	100.3	100.1	100.1	99.9	99.3	95.5	91.5	88.3	85.6	85.1	131.3

Table 24

MODEL SOUND PRESSURE LEVELS (59°F, 70% Relative Humidity, Day)

Angles from Inlet in Degrees (and Radians)

FREQ.	0. (0.)	10. (0.17)	20. (0.35)	30. (0.52)	40. (0.70)	50. (0.87)	60. (1.05)	70. (1.22)	80. (1.40)	90. (1.57)	100. (1.75)	110. (1.92)	PWL
					NON-POROUS CHAMBER (DOORS TO FIL-								
RADIAL 17. FT.					TER HOUSE OPEN) CORRECTED SPEED = 69%								
(5. M)	100	81.5	78.8	72.8	69.9	67.6	65.5	71.3	71.5	70.2	70.1	68.6	68.1	104.4
VEHICLE R-11	125	80.3	78.8	75.3	73.1	71.3	72.5	73.5	73.5	72.7	73.1	70.1	69.1	106.6
CONFIG OF 6	150	77.5	75.0	70.5	71.1	70.1	69.3	68.5	69.3	65.2	67.9	68.1	67.6	103.0
LOC SCHENECTADY	200	78.5	78.5	75.5	73.1	73.6	74.3	72.8	72.3	69.4	70.8	71.6	71.6	106.7
DATE 7/1/76	250	81.5	81.3	80.5	79.9	77.8	75.5	75.2	73.5	71.9	71.6	70.3	68.1	109.2
RUN 2572	315	82.5	82.3	81.5	81.9	78.6	77.5	76.0	74.5	72.2	70.6	69.1	67.6	109.9
TAPE	400	81.0	80.0	78.8	78.5	75.1	75.8	74.5	72.5	69.7	68.6	65.6	63.9	107.6
BAR 29.6 IN	500	79.3	77.1	75.1	75.1	74.5	74.1	72.7	71.3	68.9	68.3	65.3	63.8	105.8
(99895. N/M2)	630	79.3	79.3	75.3	78.3	76.1	75.1	73.5	72.3	70.1	69.1	67.1	65.5	107.4
TAMB 81. DEG F	800	78.8	78.3	78.3	78.1	76.8	75.2	73.5	71.5	69.6	68.5	67.4	65.6	107.3
(300. DEG C)	1000	75.0	75.5	75.0	75.3	75.9	75.5	72.7	71.0	69.1	65.5	63.9	63.3	106.1
TMET 75. DEG F	1250	74.5	75.6	75.5	75.6	74.3	73.2	71.5	69.3	66.9	64.5	62.9	60.3	104.8
(297. DEG C)	1600	75.1	76.3	76.3	76.1	74.1	74.0	72.5	69.6	66.9	64.8	62.9	61.3	105.2
HAC 19.80 GM/M3	2000	78.3	79.3	77.6	77.9	75.8	75.7	74.7	71.8	68.4	66.3	64.5	63.5	107.3
(.01980 KG/M3)	2500	79.6	80.3	79.6	80.5	79.3	78.2	76.9	74.1	69.9	68.7	66.5	64.3	109.6
NFA 11345. RPM	3150	82.0	82.1	81.6	82.6	81.8	82.2	81.2	78.3	75.1	72.2	69.5	66.7	112.6
(1188. RAD/SEC)	4000	83.7	84.7	84.7	84.5	84.2	84.8	84.3	81.5	77.8	76.1	71.6	71.4	115.6
NFC 11113. RPM	5000	84.4	85.7	85.5	85.5	85.6	86.1	85.2	82.9	79.0	76.0	73.0	72.1	116.8
(1164. RAD/SEC)	6300	86.2	86.9	87.7	89.3	88.9	88.9	87.9	85.9	81.9	78.4	75.5	74.5	119.5
NFD 10100. RPM	8000	94.5	97.1	98.8	100.5	100.4	100.9	100.1	100.7	101.1	96.4	94.5	91.1	137.0
(1686. RAD/SEC)	10000	87.8	88.9	89.9	92.5	93.2	94.8	94.2	93.2	87.8	83.9	81.5	79.0	125.2
NO. OF BLADES 44	12500	87.5	88.4	89.3	90.7	91.8	91.1	90.2	88.4	83.2	78.8	75.7	73.7	122.0
FAN TIP SPEED	15000	97.0	95.4	94.5	95.5	97.5	98.9	97.8	97.0	91.1	86.9	82.8	80.6	129.7
895. FT/SEC	20000	95.9	88.5	89.5	91.4	91.1	91.1	89.6	88.2	82.3	77.4	72.8	70.7	122.7
	25000	95.6	87.9	91.7	94.4	93.5	94.1	93.9	91.4	85.9	78.9	74.3	72.1	126.3
	31500	93.7	84.1	87.3	90.3	89.5	89.8	89.1	86.5	80.2	72.9	68.1	65.2	122.9
	40000	78.0	79.8	82.7	86.3	86.5	86.0	84.7	82.1	75.3	68.1	62.5	62.0	119.9
	50000	76.1	76.2	79.4	81.5	81.4	82.4	81.8	79.5	72.0	64.2	60.1	63.0	118.4
	63000	72.0	72.8	75.5	77.3	78.1	79.4	78.3	75.6	68.8	62.0	60.0	64.8	117.5
	80000	68.2	68.2	70.1	71.0	70.8	71.5	71.5	69.2	62.7	58.5	58.7	66.4	115.0
OVERALL SOUNDLEVEL	101.5	101.8	102.5	103.3	103.4	103.3	102.5	100.9	102.0	97.5	95.3	92.0	138.9	

Table 25

MODEL SOUND PRESSURE LEVELS (59°F, 70% Relative Humidity, Day)

Angles from Inlet in Degrees (and Radians)

	FREQ.	0. (0.)	10. (0.17)	20. (0.35)	30. (0.52)	40. (0.70)	50. (0.87)	60. (1.05)	70. (1.22)	80. (1.40)	90. (1.57)	100. (1.75)	110. (1.92)	PWL
	50													
	53					NON-POROUS CHAMBER (DOORS TO FIL-								
RADIAL 17. FT.	63					TER HOUSE OPEN) CORRECTED SPEED = 86%								
(5. M)	100	82.5	83.3	72.0	67.5	69.8	70.3	72.5	72.6	71.5	71.9	71.0	69.0	106.3
VEHICLE R-11	125	81.5	91.3	73.5	69.5	71.0	71.3	72.5	71.5	71.3	72.3	70.0	69.6	105.9
CONFIG OF 6	150	79.5	75.3	73.3	65.1	71.8	72.5	72.5	72.8	69.3	70.6	71.0	70.3	105.5
LOC SOUTHEAST	200	79.5	79.5	74.8	74.5	74.5	74.0	73.7	75.2	74.3	73.6	05.3	71.1	107.6
DATE 7/1/75	250	81.0	79.3	81.5	81.9	81.7	79.5	91.0	83.2	84.2	83.0	76.6	80.3	115.5
RUN 2573	315	79.5	79.3	77.3	75.6	75.2	74.2	73.5	72.2	69.0	68.0	00.0	66.3	106.6
TAPE	400	79.3	79.0	75.8	75.8	75.2	75.0	74.5	73.0	56.5	55.3	00.6	65.3	106.7
BAR 29.5 IN	500	77.3	75.5	74.5	74.5	74.3	73.7	73.2	72.2	55.7	70.3	00.6	65.0	105.7
(99896. N/M2)	630	78.8	77.8	77.0	75.5	75.6	75.5	74.2	73.0	70.2	70.3	67.4	65.3	107.1
TAMB 52. DEG F	800	77.3	77.3	76.6	77.1	77.3	77.0	74.7	73.2	71.0	72.0	00.0	65.5	107.9
(301. DEG K)	1000	78.3	77.8	78.3	79.3	80.2	80.9	78.0	76.2	75.2	72.0	69.4	67.3	110.6
TWET 74. DEG F	1250	82.3	79.8	81.0	82.3	83.7	84.4	84.2	81.5	81.5	78.0	72.4	72.6	115.0
(295. DEG K)	1500	81.1	79.8	80.6	82.5	83.0	83.7	82.5	80.5	78.5	73.5	74.2	72.3	114.0
HAC(18.53 GM/M3	2000	84.3	84.3	83.3	83.9	84.5	85.9	85.2	83.8	82.5	77.7	77.3	76.2	117.6
(.01853 KG/M3)	2500	82.8	82.8	83.1	84.1	84.7	87.7	89.2	90.0	88.5	84.7	79.5	80.5	120.4
NFA 14157. RPM	3150	88.3	85.5	85.8	85.9	88.2	95.1	97.9	100.0	95.2	94.9	89.8	88.2	129.4
(1482. RAD/SEC)	4000	93.3	93.7	94.9	93.3	97.6	104.1	109.3	109.4	105.9	103.0	101.0	100.3	139.0
NFC 13483. RPM	5000	96.9	94.7	98.1	98.8	101.8	108.3	111.2	111.4	108.6	104.2	101.5	99.5	140.9
(1411. RAD/SEC)	6300	94.0	92.4	95.3	96.2	98.5	102.1	105.9	106.3	102.9	99.7	94.3	92.5	135.9
NFD 12199. RPM	8000	93.5	95.1	95.8	97.5	98.6	100.3	103.5	104.4	99.6	96.6	92.7	88.1	134.0
(1586. RAD/SEC)	10000	103.3	105.9	107.2	108.1	109.1	108.7	109.0	108.6	103.4	98.9	95.3	93.0	140.2
NO. OF BLADES 44	12500	94.1	95.4	97.3	96.5	99.3	100.8	103.0	102.3	97.8	94.3	89.7	86.0	133.4
FAN TIP SPEED	15000	92.2	93.7	95.6	97.9	98.7	100.1	101.0	101.0	96.7	91.1	00.5	84.1	132.3
1225. FT/SEC	20000	93.5	95.7	96.9	93.4	99.8	99.4	99.8	98.2	93.7	89.2	83.3	80.6	131.6
	25000	89.4	90.7	92.5	94.3	94.7	95.3	95.8	95.1	92.3	85.4	79.6	77.4	128.8
	31500	86.1	89.1	91.0	92.4	92.6	94.1	93.7	93.0	88.4	81.0	74.7	74.8	127.4
	40000	83.9	84.9	87.2	88.2	88.7	89.8	90.5	89.0	84.8	77.0	70.2	72.1	124.9
	50000	83.5	84.2	84.2	84.9	86.6	86.9	87.8	87.0	81.6	73.9	67.6	72.3	123.9
	63000	78.9	77.4	80.2	80.9	82.8	84.2	84.3	83.4	79.9	73.6	67.6	73.9	123.5
	80000	73.3	73.7	74.4	73.3	78.5	80.4	80.8	79.1	73.5	67.9	66.9	73.4	123.4
OVERALL CALCULATED		105.3	105.3	104.5	110.7	111.2	113.3	115.2	115.3	112.7	108.9	100.5	104.2	146.6

Table 26

MODEL SOUND PRESSURE LEVELS (59°F, 70% Relative Humidity, Day)

Angles from Inlet in Degrees (and Radians)

NON-POROUS CHAMBER (DOORS TO FILTER HOUSE OPEN) CORRECTED SPEED = 90%

FREQ.	0. (0.)	10. (0.17)	20. (0.35)	30. (0.52)	40. (0.70)	50. (0.87)	60. (1.05)	70. (1.22)	80. (1.40)	90. (1.57)	100. (1.75)	110. (1.92)	PWL
50													
63													
80													
100	86.1	84.5	72.3	65.1	69.3	70.3	71.5	72.0	70.0	71.1	70.5	69.6	106.3
125	83.0	81.3	72.8	67.1	69.5	70.3	71.8	72.0	71.8	72.3	70.3	69.0	105.9
160	81.3	79.3	70.8	66.9	71.5	72.3	72.5	73.3	70.5	71.3	72.3	71.3	106.0
200	81.1	79.3	71.8	69.9	71.2	71.3	71.5	70.7	67.0	67.3	66.3	66.1	104.1
250	84.0	83.5	78.3	79.4	79.2	78.7	76.5	77.2	79.5	80.8	78.3	77.6	112.6
315	78.8	78.1	74.3	73.1	73.0	72.7	71.7	70.2	67.0	67.3	66.8	65.3	104.7
400	77.3	75.3	73.5	73.1	73.2	73.2	72.2	72.0	66.5	66.5	65.6	65.6	104.7
500	77.1	74.8	74.1	73.8	74.0	73.3	72.7	70.5	69.3	68.0	64.3	66.3	104.9
630	83.0	78.8	81.3	79.6	77.5	74.2	75.0	71.5	70.0	68.8	65.9	67.6	108.5
800	77.0	75.5	76.5	75.7	75.1	74.7	74.0	74.0	69.5	69.2	66.6	67.3	106.7
1000	79.0	78.5	79.0	79.5	82.2	81.4	80.5	80.0	78.4	78.5	73.6	74.5	112.5
1250	80.3	80.3	79.0	80.8	85.2	84.7	81.5	85.3	83.5	75.7	79.4	77.0	116.1
1600	85.6	81.8	84.6	84.4	82.3	86.0	88.2	86.8	85.0	79.5	81.2	79.5	118.3
2000	84.5	90.5	90.8	90.5	91.2	100.7	103.5	102.3	99.0	96.0	94.8	92.2	132.7
2500	85.0	85.3	86.1	90.9	94.2	98.7	101.9	101.3	98.0	96.4	91.6	91.0	131.5
3150	84.0	87.1	87.0	92.4	90.2	99.1	102.9	102.2	98.5	93.9	91.6	90.4	131.9
4000	92.0	92.7	93.2	99.5	98.5	104.3	106.6	106.7	103.4	99.0	97.0	95.9	136.6
5000	94.4	95.4	97.4	101.3	102.5	107.1	109.5	108.9	105.1	100.5	99.3	96.5	139.0
6300	93.2	94.2	96.0	99.5	100.0	103.1	105.4	103.8	100.4	96.4	92.8	91.7	134.8
8000	92.5	94.5	94.5	97.1	97.8	100.1	100.6	102.1	97.9	93.1	90.5	86.1	132.0
10000	105.1	103.9	106.4	107.1	107.1	107.5	109.2	109.1	105.1	100.9	97.5	93.2	140.2
12500	99.0	99.5	100.8	102.0	101.8	102.5	103.7	104.3	99.8	95.0	91.7	87.9	135.2
15000	93.0	94.1	95.8	98.1	98.9	100.4	101.0	100.9	96.7	91.1	88.4	83.8	132.4
20000	94.2	95.4	95.6	97.9	98.8	99.5	99.8	99.7	94.7	89.4	84.0	80.6	131.9
25000	90.9	91.9	93.8	95.0	95.5	96.7	97.8	96.9	92.5	85.8	80.8	77.4	129.8
31500	88.7	89.5	90.7	92.9	93.8	94.1	94.4	93.7	89.1	81.7	76.1	73.2	127.8
40000	83.3	84.7	85.6	86.2	89.1	90.3	91.3	91.0	85.8	77.7	70.9	71.0	125.7
50000	81.6	82.1	83.6	85.3	85.8	87.7	88.2	88.1	83.0	75.5	68.5	72.1	124.6
63000	75.7	76.0	79.0	80.8	82.7	84.5	85.0	85.0	80.1	71.6	67.2	73.5	124.1
80000	70.5	71.6	72.7	73.1	78.6	80.2	81.4	80.4	74.6	68.0	68.6	72.7	123.8
OVERALL CALCULATION	108.3	108.5	109.3	111.0	111.5	113.8	115.8	115.5	111.6	107.4	104.9	102.4	146.2

RADIAL 17. FT. (5. M)
VEHICLE R-11
CONFIG DF 5
LOC SCHENECTADY
DATE 7/1/75
RUN 26/4
TAPE
BAR 29.4 IN
(99595. N/M2)
TAMB 81. DEG F
(300. DEG K)
INLET 74. DEG F
(296. DEG K)
HADT 18.93 GM/M3
(.01383 KG/M3)
NFA 14796. RPM
(1549. RAD/SEC)
NFC 14491. RPM
(1517. RAD/SEC)
NFD 14100. RPM
(1476. RAD/SEC)
NO. OF BLADES 44
FAN TIP SPEED
(1281. FT/SEC)

Table 27

MODEL SOUND PRESSURE LEVELS (59°F, 70% Relative Humidity, Day)

Angles from Inlet in Degrees (and Radians)

	FREQ.	0. (0.)	10. (0.17)	20. (0.35)	30. (0.52)	40. (0.70)	50. (0.87)	60. (1.05)	70. (1.22)	80. (1.40)	90. (1.57)	100. (1.75)	110. (1.92)	PWL
	50													
	63						NON-POROUS CHAMBER (DOORS TO FIL-							
RADIAL FT.	80						TER HOUSE OPEN) CORRECTED SPEED = 100%							
(M)	100	86.6	85.2	75.5	69.4	72.3	70.5	72.3	73.0	72.0	72.8	72.6	72.1	107.8
VEHICLE R=11	125	84.1	84.0	74.3	67.6	71.8	70.4	72.5	73.5	73.3	74.6	73.6	73.0	107.9
SONIC TIP S	160	82.3	81.0	73.0	67.1	73.5	72.0	73.8	74.8	74.0	75.3	76.3	75.0	108.6
LOC SCHENECTADY	200	81.6	80.3	71.8	66.9	72.2	70.6	71.0	70.0	69.3	69.3	69.0	66.0	103.7
DATE 7/17/70	250	85.3	89.6	88.6	90.6	88.6	84.7	82.7	84.2	80.0	75.3	77.3	79.0	116.4
RUN 2576	315	81.3	84.0	83.0	84.0	83.2	79.2	77.0	78.5	75.0	71.3	72.3	74.3	112.9
TAPE	400	75.1	75.0	69.3	69.3	72.0	71.5	72.2	71.2	69.7	65.3	69.8	69.0	103.3
BAR 29.5 IN	500	74.0	75.0	75.5	75.3	77.3	77.2	75.2	80.2	78.0	69.0	66.1	63.0	110.2
(99836. N/M2)	630	73.5	75.5	73.8	73.1	79.3	74.2	75.0	76.5	73.7	67.3	64.9	64.0	107.7
TAMB 81. DEG F	800	73.0	74.3	72.3	81.1	81.8	79.5	80.0	80.7	77.7	75.2	74.4	73.0	112.1
(300. DEG K)	1000	72.5	79.8	82.0	89.5	88.2	89.4	91.2	90.5	89.9	83.7	84.1	82.6	121.8
TWET 74. DEG F	1250	87.0	81.8	84.8	88.1	96.2	97.4	98.5	98.0	93.0	92.7	89.7	88.0	128.6
(295. DEG K)	1500	93.1	83.1	89.3	92.5	98.5	100.7	102.7	101.0	96.0	95.2	95.0	92.3	132.3
HAC 18.83 GM/M3	2000	83.8	84.1	87.1	91.6	96.2	99.2	100.2	97.8	94.7	93.0	90.8	89.7	129.7
(.01393 KG/M3)	2500	85.0	85.1	86.3	90.1	96.2	100.2	100.7	99.0	93.7	92.7	89.6	87.0	130.0
NFA 5439. RPM	3150	84.0	83.1	85.0	89.6	89.7	94.9	96.6	95.0	91.0	88.1	84.3	83.7	125.5
(1721. RAD/SEC)	4000	85.2	86.0	85.9	88.6	90.1	95.9	96.6	94.2	90.4	88.6	86.3	85.3	125.9
NFC 6414. RPM	5000	90.9	93.2	93.9	97.5	100.3	105.7	104.7	101.9	97.6	94.0	95.8	90.3	134.5
(1585. RAD/SEC)	5300	92.7	92.9	94.9	98.2	101.3	102.5	101.7	101.6	98.4	93.9	91.8	89.2	133.0
NFD 16100. RPM	8000	91.6	93.1	93.9	96.8	99.8	102.6	101.3	99.4	96.1	92.3	89.2	87.1	132.0
(1686. RAD/SEC)	10000	97.8	100.2	101.2	102.3	103.3	104.5	105.0	101.6	97.6	93.9	90.3	88.5	135.1
NO. OF BLADES 44	12500	105.3	107.5	108.6	109.5	111.0	111.5	112.2	108.8	104.3	100.5	96.4	94.1	142.3
FAN TIP SPEED	15000	93.0	94.1	96.3	97.9	98.6	100.1	100.0	98.2	94.2	89.1	84.9	82.0	131.3
1424. FT/SEC	20000	92.2	93.7	95.1	97.2	97.6	99.0	99.3	97.4	92.9	87.9	83.6	79.0	130.8
	25000	94.0	94.9	97.0	98.5	99.0	100.2	101.8	98.4	94.0	87.0	82.0	79.4	132.9
	31500	87.5	88.9	90.7	92.9	93.5	95.5	95.9	94.0	88.5	81.4	75.9	73.0	128.6
	40000	84.3	85.7	89.1	89.9	90.9	93.1	93.3	90.5	85.0	78.0	71.4	72.0	127.1
	50000	80.0	82.1	84.3	85.5	88.0	90.0	90.7	88.1	81.7	74.5	68.3	73.0	126.1
	63000	77.1	77.3	82.5	82.1	84.9	87.7	88.2	85.0	78.5	70.9	67.0	75.5	125.9
	80000	73.0	73.3	75.5	74.4	80.1	82.5	82.6	80.2	73.1	67.6	66.6	74.0	124.8
OVERALL CALCULATED		108.1	109.4	110.6	111.9	113.1	114.9	115.5	112.9	108.8	105.3	103.0	100.4	145.9

Table 28

MODEL SOUND PRESSURE LEVELS (59°F, 70% Relative Humidity, Day)

Angles from Inlet in Degrees (and Radians)

FREQ.	0. (0.)	10. (0.17)	20. (0.35)	30. (0.52)	40. (0.70)	50. (0.87)	60. (1.05)	70. (1.22)	80. (1.40)	90. (1.57)	100. (1.75)	110. (1.92)	PWL
					NON-POROUS CHAMBER (DOORS TO FIL-								
RADIAL 17. FT.					TER HOUSE OPEN) CORRECTED SPEED = 86% (REPEAT)								
(5. M)	100	85.3	84.5	71.5	66.9	69.5	70.3	72.3	73.0	71.8	71.6	71.9	69.6	106.7
VEHICLE T-11	125	83.5	81.3	73.8	69.9	69.8	70.6	72.5	72.3	71.5	73.1	70.3	69.1	106.0
CONFIG OF 6	150	81.1	75.3	70.0	68.1	70.8	71.3	71.5	72.0	69.8	70.3	71.3	70.3	105.1
LOC SCHENECTADY	200	80.8	79.3	74.8	73.9	74.2	74.2	72.5	74.7	75.0	73.5	67.3	70.0	118.1
DATE 7/1/75	250	81.5	79.3	81.5	81.5	82.5	79.0	79.2	83.5	84.5	83.3	74.8	79.0	115.4
RUN 2575	315	79.8	79.3	77.5	77.1	75.2	74.7	73.7	72.2	69.2	68.5	67.3	66.3	106.9
TAPE	400	79.1	78.5	75.8	75.1	75.0	74.2	73.5	72.7	69.5	68.0	66.3	65.3	106.4
BAR 29.5 HG	500	77.3	75.3	75.0	75.1	74.3	74.0	73.2	71.5	69.2	68.0	65.8	64.5	105.5
(99896. N/M2)	630	78.3	78.1	77.0	76.6	76.5	75.7	74.2	73.0	70.2	69.8	67.4	66.5	107.1
TAMB 80. DEG F	800	77.0	77.0	77.0	77.3	77.0	76.7	75.5	73.2	71.2	71.2	69.1	66.8	107.9
(300. DEG C)	1000	77.5	77.5	78.0	79.3	80.5	81.2	79.2	76.7	75.9	71.2	69.9	68.0	110.9
TAR 74. DEG F	1250	81.3	80.1	80.8	82.3	83.0	85.2	84.5	82.0	82.0	78.0	73.2	72.0	115.4
(296. DEG C)	1500	91.8	79.5	80.9	82.9	83.3	83.2	82.5	80.0	78.2	73.5	74.0	71.5	113.8
HAC 19.13 GM/M3	2000	84.1	84.1	82.8	83.9	83.2	85.7	87.0	84.0	81.7	77.2	77.0	75.0	116.7
(.01913 KG/M3)	2500	83.3	83.1	83.1	84.4	85.5	89.2	90.9	91.8	90.0	87.2	81.1	82.5	122.0
NFA 14135. RPM	3150	89.0	87.1	85.8	86.9	89.2	96.9	99.4	101.0	99.2	96.1	90.8	89.6	130.6
(1480. RAD/SEC)	4000	93.2	94.3	94.7	98.3	97.3	105.9	110.3	110.2	105.9	103.0	101.0	100.3	139.7
NFS 13860. RPM	5000	95.9	94.9	96.9	99.6	101.0	108.5	112.0	111.8	108.6	103.9	102.3	100.0	141.3
(1451. RAD/SEC)	5300	96.7	95.2	96.7	96.5	98.5	102.4	107.2	107.3	102.9	100.2	94.8	93.4	136.7
NFD 16100. RPM	6300	93.3	94.9	95.5	97.3	98.3	99.5	103.8	104.6	99.9	96.8	93.0	89.6	134.0
(1685. RAD/SEC)	10000	103.5	105.9	106.7	108.1	108.1	106.2	105.9	108.1	102.9	98.9	95.8	93.7	140.0
NO. OF BLADES 44	12500	94.3	95.5	97.3	98.7	99.0	100.5	102.2	103.1	99.3	94.5	90.4	87.4	133.4
FAN TIP SPEED	15000	92.7	94.1	96.0	97.6	98.6	100.5	101.3	100.9	95.9	91.6	87.8	84.6	132.4
1224. FT/SEC	20000	94.2	95.7	96.5	98.6	99.8	100.9	99.8	99.1	93.9	88.9	84.0	80.9	131.9
	25000	89.9	90.4	92.5	94.5	94.7	96.2	97.2	95.3	92.9	85.6	80.3	77.6	129.8
	31500	89.0	89.3	90.9	92.6	92.8	94.1	94.4	93.4	88.3	81.9	76.1	74.4	127.6
	40000	84.3	84.9	87.0	89.4	89.3	91.2	90.7	89.9	83.2	77.9	71.1	72.2	125.5
	50000	81.1	81.7	83.7	85.0	85.9	87.6	86.4	87.3	81.6	74.7	67.9	71.6	124.3
	63000	77.1	77.9	80.2	80.4	82.8	85.2	84.8	84.4	78.9	71.3	67.1	73.4	124.0
	80000	71.4	73.1	74.8	72.9	78.7	80.1	80.9	80.8	73.4	67.6	68.6	71.6	123.4
OVERALL CALCULATED		106.7	108.1	109.0	110.7	111.0	113.6	115.8	116.7	112.7	109.0	106.2	104.9	147.0

Table 29

MODEL SOUND PRESSURE LEVELS (59°F, 70% Relative Humidity, Day)

Angles from Inlet in Degrees (and Radians)

	FREQ.	0. (0.)	10. (0.17)	20. (0.35)	30. (0.52)	40. (0.70)	50. (0.87)	60. (1.05)	70. (1.22)	80. (1.40)	90. (1.57)	100. (1.75)	110. (1.92)	PWL
	50													
	63					NON-POROUS CHAMBER (DOORS TO FIL-								
RADIAL	80					TER HOUSE OPEN) CORRECTED SPEED =							69% (REPEAT)	
(30. M)	100	74.5	75.2	72.8	69.9	67.6	74.0	71.0	71.3	70.4	70.4	69.1	67.9	105.0
VEHICLE R-11	125	79.3	78.5	75.5	75.1	71.5	73.3	73.3	73.0	72.9	74.1	71.3	69.9	106.9
CONFIG DF 6	160	76.3	75.3	71.3	71.1	70.3	72.8	68.5	69.0	67.9	68.1	67.0	67.4	103.5
LOC SCHENECTADY	200	77.3	78.5	76.5	75.4	74.3	77.5	72.8	72.5	69.4	71.1	71.8	72.9	107.5
DATE 7/1/75	250	81.9	81.1	80.8	80.1	77.8	78.5	75.9	73.3	72.2	71.8	70.5	67.8	109.2
RUN 26/7	315	82.3	82.3	81.3	81.1	78.8	77.5	75.2	74.5	71.4	70.0	69.3	68.1	109.9
TAPE	400	81.3	80.3	79.3	79.1	76.8	76.1	74.2	72.8	70.2	68.6	65.6	64.3	108.0
BAR 29.5 IN	500	79.0	77.0	75.0	75.3	74.3	73.8	72.7	71.0	69.1	67.3	65.3	63.6	105.7
(99896. N/M2)	630	80.0	79.5	79.0	78.3	76.3	76.3	73.7	72.3	70.1	68.8	67.4	65.6	107.7
TAMB 80. DEG F	800	79.5	78.8	78.0	78.6	77.1	76.2	74.0	72.3	69.4	69.0	67.6	65.6	107.7
(300. DEG K)	1000	77.8	75.8	76.0	77.0	75.1	77.7	73.5	70.3	68.6	66.8	64.1	63.1	106.8
TAMB 74. DEG F	1250	75.3	75.8	75.5	75.3	74.5	78.0	72.2	69.6	65.9	65.0	63.7	61.4	106.2
(296. DEG K)	1500	77.8	76.3	76.6	76.1	74.8	75.0	72.5	70.1	66.7	65.4	62.0	61.8	105.6
HAST 19.13 GM/M3	2000	78.3	79.3	78.6	78.4	77.6	80.2	75.0	72.1	68.4	66.3	64.3	63.6	108.7
(.01913 KG/M3)	2500	80.1	80.5	79.8	80.9	79.3	81.3	76.9	73.8	70.9	68.2	67.3	64.8	110.3
NFA 11328. RPM	3150	81.8	82.5	82.3	82.5	81.5	82.7	81.2	79.0	75.1	72.2	68.6	68.7	113.0
(1186. RAD/SEC)	4000	83.7	84.5	84.2	84.6	84.2	84.3	83.8	81.2	77.1	75.6	72.1	71.1	115.2
NFC 11102. RPM	5000	84.7	85.7	85.9	86.0	85.8	85.8	85.5	82.4	79.0	76.0	73.5	71.6	116.7
(1162. RAD/SEC)	5300	85.0	87.2	85.6	89.0	89.1	89.2	86.4	85.6	81.0	77.2	75.3	74.0	119.5
NFD 15100. RPM	8000	95.3	97.1	99.3	102.0	103.4	105.5	105.6	104.7	100.8	95.4	94.2	90.9	136.6
(1685. RAD/SEC)	10000	88.1	89.9	90.4	92.1	92.6	94.3	94.0	92.4	87.5	82.9	81.0	78.3	124.8
NO. OF BLADES 44	12500	87.3	88.4	90.0	91.5	90.3	90.1	90.0	87.9	82.5	78.1	75.4	73.7	121.7
FAN TIP SPEED	15000	94.0	96.1	94.8	96.3	97.2	98.4	97.8	96.5	90.6	86.6	82.4	80.6	129.4
991. FT/SEC	20000	87.4	88.9	89.4	91.4	90.9	91.3	89.5	87.7	81.8	76.9	73.0	70.9	122.6
	25000	84.3	87.7	91.5	94.5	93.8	94.2	93.5	90.4	86.2	79.1	74.3	72.4	126.3
	31500	84.0	84.5	87.9	90.1	90.1	90.5	89.4	86.2	80.5	73.2	68.4	65.5	123.2
	40000	79.8	80.4	83.5	85.1	85.4	87.0	85.2	82.4	75.4	67.9	62.8	61.8	120.4
	50000	75.7	77.3	79.7	81.5	81.5	84.4	81.9	78.8	72.5	64.0	60.7	62.6	118.9
	63000	72.6	73.1	76.2	77.4	78.2	81.2	78.6	75.4	69.1	62.1	60.6	64.2	118.2
	80000	68.6	68.1	71.0	70.9	70.7	75.5	71.2	69.3	62.5	58.9	59.1	64.6	116.0
OVERALL CALCULATED		101.9	101.8	102.8	105.0	105.7	108.1	107.9	105.0	101.8	96.6	95.1	92.1	138.6

Table 30

MODEL SOUND PRESSURE LEVELS (59°F, 70% Relative Humidity, Day)

Angles from Inlet in Degrees (and Radians)

BASELINE CLEAN CHAMBER (REPEAT)
CORRECTED SPEED = 54%

RADIAL 17. FT.
(5. M)
VEHICLE R-11
CONFIG CF 6
LOC SCHENECTADY
DATE 8/11/76
RUN 30/3
TAPE
BAR 29.9 HG
(1039. N/M2)
TAMB 84. DEG F
(302. DEG K)
TWET 75. DEG F
(297. DEG K)
HACT 18.88 GM/M3
(.01888 KG/M3)
NFA 8901. RPM
(932. RAD/SEC)
NFK 8694. RPM
(910. RAD/SEC)
NFD 16100. RPM
(1686. RAD/SEC)
NO. OF BLADES 44
FAN TIP SPEED
771. FT/SEC

FREQ.	0. (0.)	10. (0.17)	20. (0.35)	30. (0.52)	40. (0.70)	50. (0.87)	60. (1.05)	70. (1.22)	80. (1.40)	90. (1.57)	100. (1.75)	110. (1.92)	0. (0.)	0.	PWL
50															
63															
80															
100	70.0	69.3	68.8	66.8	65.3	65.6	67.7	68.5	68.1	68.0	66.9	65.8			101.1
125	75.7	75.3	75.1	72.3	71.3	71.9	73.2	73.3	73.1	72.7	72.2	70.8			106.4
160	69.2	68.0	66.8	67.3	68.8	67.1	66.9	70.0	72.3	65.7	70.7	72.0			103.4
200	72.7	75.0	74.3	72.1	71.1	70.6	68.7	68.8	67.8	66.7	63.9	63.0			103.0
250	78.5	77.5	77.8	76.8	75.8	73.6	72.7	70.5	70.3	70.5	68.4	65.5			106.6
315	79.0	79.8	78.6	77.5	77.1	75.1	73.2	71.8	69.8	68.7	66.9	66.0			107.3
400	74.0	74.3	73.8	72.8	71.8	70.4	68.4	66.3	64.6	64.5	62.2	59.3			102.3
500	71.2	71.0	71.6	70.8	69.8	69.1	67.9	66.5	64.8	64.0	61.0	58.5			100.9
630	72.7	73.3	73.1	72.5	71.8	69.9	67.9	66.3	65.0	64.7	62.5	59.5			102.0
800	72.7	72.5	72.6	72.2	71.6	69.8	67.9	65.8	64.5	64.4	62.7	59.5			101.8
1000	69.2	69.8	70.3	70.2	69.8	68.3	66.4	63.8	61.3	58.9	58.2	56.5			99.6
1250	70.0	71.1	71.6	71.3	70.3	68.3	66.4	64.0	61.8	59.7	58.8	56.0			100.2
1600	71.0	71.8	72.1	71.0	70.8	69.3	67.4	64.8	62.3	61.2	58.4	57.0			100.8
2000	73.5	74.6	74.4	74.3	73.6	72.6	71.1	67.6	64.3	63.1	60.2	60.0			103.7
2500	76.7	77.3	76.4	76.6	76.3	75.1	73.1	70.0	67.1	64.9	62.4	60.9			106.1
3150	79.0	79.3	78.6	79.1	79.2	79.3	77.6	73.8	70.5	67.6	66.0	64.9			109.4
4000	80.6	81.2	81.5	81.8	81.9	81.7	80.0	76.5	72.5	70.2	68.2	67.6			112.0
5000	83.1	83.9	84.2	85.0	84.6	83.1	80.9	76.4	73.2	71.1	68.9	67.5			113.9
6300	94.7	94.2	95.5	95.9	96.4	95.3	93.6	89.6	85.9	84.9	81.7	80.4			125.9
8000	84.3	85.6	86.3	87.2	87.9	87.2	84.5	79.9	76.0	74.3	72.1	70.6			117.2
10000	84.0	85.2	86.0	8 .0	88.1	87.4	84.9	80.2	75.5	73.1	71.4	70.2			117.4
12500	94.5	92.4	93.8	94.7	93.6	93.2	92.9	87.9	83.4	80.0	77.8	75.9			124.5
15000	84.2	85.2	87.1	88.1	88.2	86.3	85.5	81.0	75.5	72.6	69.8	69.6			118.2
20000	83.4	85.4	87.0	89.9	94.6	91.2	88.3	84.2	79.0	74.1	71.4	69.4			122.6
25000	80.6	82.0	84.6	85.	86.8	87.4	85.5	80.7	74.1	68.8	66.5	65.6			118.5
31500	77.8	76.1	81.0	83.1	83.5	83.0	81.9	76.6	69.0	64.9	60.6	61.7			115.7
40000	75.8	74.5	77.5	78.7	80.3	79.5	77.8	72.1	64.7	61.0	58.1	59.6			113.3
50000	74.8	72.2	75.0	75.3	76.2	75.7	73.8	68.3	61.6	58.8	57.3	58.7			111.4
63000	72.0	68.4	70.7	71.1	71.9	71.6	69.0	63.2	59.0	58.0	56.2	58.6			109.9
80000	65.4	62.7	65.0	64.5	64.9	64.1	62.8	59.2	55.9	53.9	54.1	55.9			107.6
OVERALL CALCULATED	96.9	96.4	99.6	100.4	101.2	99.9	98.4	94.0	89.9	87.9	85.4	84.1			131.0

Table 31

MODEL SOUND PRESSURE LEVELS (59°F, 70% Relative Humidity, Day)

Angles from Inlet in Degrees (and Radians)

BASELINE CLEAN CHAMBER (REPEAT)
CORRECTED SPEED = 69%

RADIAL 17. FT. (5. M)
VEHICLE R-11
CONFIG CF 6
LOC SCHENECTADY
DATE 8/11/76
RUN 30/4
TAPE
BAR 30.0 HG (01172. N/M2)
TAMB 85. DEG F (303. DEG K)
TWET 75. DEG F (297. DEG K)
HACT18.57 GM/M3 (.01857 KG/M3)
NFA 11384. RPM (1192. RAD/SEC)
NFK 11109. RPM (1163. RAD/SEC)
NFB 16100. RPM (1686. RAD/SEC)
NO. OF BLADES 44
FAN TIP SPEED 986. FT/SEC

FREQ.	0. (0.)	10. (0.17)	20. (0.35)	30. (0.52)	40. (0.70)	50. (0.87)	60. (1.05)	70. (1.22)	80. (1.40)	90. (1.57)	100. (1.75)	110. (1.92)	0. (0.)	0.	PWL
50															
63															
80															
100	71.2	71.0	70.3	69.4	67.1	67.8	70.5	71.0	70.2	70.4	69.4	68.5			103.4
125	75.7	76.0	75.6	73.1	71.8	72.3	73.5	73.3	72.9	73.9	72.4	71.3			106.8
160	71.5	70.3	69.3	70.1	70.3	69.5	68.5	69.0	68.7	68.4	68.7	67.8			102.7
200	74.5	76.3	76.3	74.1	73.3	73.0	72.0	71.0	68.9	69.8	70.4	71.5			105.8
250	81.2	80.3	80.3	79.9	78.3	76.5	74.7	73.0	72.2	72.3	71.4	68.8			109.1
315	81.7	82.3	81.3	80.6	79.1	77.5	75.7	74.0	71.9	70.8	69.7	68.3			109.8
400	79.0	78.8	78.8	77.8	76.3	74.5	73.2	71.0	69.2	68.6	66.7	63.8			107.0
500	75.7	75.8	76.1	75.8	74.3	73.8	72.7	71.3	69.1	67.8	65.0	62.5			105.5
630	77.5	77.8	78.1	77.6	76.6	74.8	72.7	71.3	70.1	69.1	67.2	64.3			106.9
800	77.7	77.5	77.8	77.8	76.6	74.7	73.0	71.0	69.1	68.5	67.2	64.2			106.8
1000	74.2	74.8	74.8	75.5	75.3	73.7	72.0	70.0	67.1	63.3	64.7	63.0			105.0
1250	73.5	74.8	75.6	75.1	73.8	72.0	70.5	68.1	65.6	64.0	62.3	60.2			104.0
1600	73.2	75.1	74.9	74.9	73.6	72.5	71.0	68.3	65.7	63.8	62.1	60.5			104.0
2000	77.2	77.6	77.1	77.6	76.8	75.5	73.5	70.8	66.9	64.8	63.4	62.2			106.6
2500	79.2	78.8	79.6	80.6	79.3	78.0	75.9	72.3	69.2	67.0	65.7	63.7			109.1
3150	81.0	81.1	81.1	81.4	81.3	80.2	78.9	75.0	71.4	69.2	68.0	66.2			111.1
4000	83.4	83.7	83.5	84.1	83.2	83.1	81.8	77.5	74.3	72.8	70.2	68.8			113.7
5000	84.1	84.7	85.4	85.8	85.6	85.5	84.7	80.6	77.3	75.8	72.9	71.0			116.1
6300	84.9	85.9	87.3	88.5	88.4	87.9	86.4	82.9	78.3	76.0	74.2	72.7			118.3
8000	94.3	96.1	98.1	101.8	103.7	105.1	105.1	101.9	96.1	93.4	91.4	89.1			135.0
10000	87.0	88.7	90.8	92.3	93.4	93.8	93.2	90.2	84.8	81.7	79.4	77.4			124.1
12500	87.3	88.4	89.6	91.3	90.9	91.1	90.0	86.2	81.0	77.6	75.8	73.4			121.7
16000	99.2	94.4	93.9	97.9	98.0	98.2	97.1	93.8	88.4	84.4	81.8	79.1			128.9
20000	88.4	88.5	89.5	91.7	91.9	91.6	89.6	86.0	79.9	75.7	72.9	70.1			122.7
25000	90.6	88.2	91.6	94.3	94.1	93.8	93.1	88.2	82.8	78.0	74.8	72.4			125.8
31500	83.5	84.7	87.8	90.5	91.0	90.2	88.8	83.9	77.6	71.6	67.9	64.5			122.9
40000	79.9	81.1	83.3	85.3	86.4	86.7	84.2	79.6	73.3	66.6	62.4	60.4			119.9
50000	75.4	77.0	79.3	81.0	82.3	82.5	80.4	75.6	68.6	63.3	59.6	58.8			117.6
63000	71.7	72.0	74.6	76.6	77.3	78.1	76.3	71.3	65.3	60.2	57.4	58.5			115.9
80000	66.1	64.9	67.7	71.5	71.1	71.9	70.8	69.1	61.7	59.5	54.0	55.6			114.5
OVERALL CALCULATED	101.8	100.8	102.1	105.1	106.1	107.0	106.6	103.3	97.7	94.8	92.7	90.5			137.4

Table 32

MODEL SOUND PRESSURE LEVELS (59°F, 70% Relative Humidity, Day)

Angles from Inlet in Degrees (and Radians)

	FREQ.	0. (0.)	10. (0.17)	20. (0.35)	30. (0.52)	40. (0.70)	50. (0.87)	60. (1.05)	70. (1.22)	80. (1.40)	90. (1.57)	100. (1.75)	110. (1.92)	0. (0.)	0. (0.)
	50	BASELINE CLEAN CHAMBER (REPEAT)													
	63	CORRECTED SPEED = 86%													PWL
RADIAL 17. FT.	80														
(5. M)	100	68.8	68.8	66.3	67.1	66.1	70.8	72.0	72.3	71.8	72.1	71.5	69.6		104.6
VEHICLE R-11	125	72.3	71.8	72.5	69.9	68.3	71.3	73.0	71.5	71.3	72.6	71.0	70.1		105.1
CONFIG CF 6	160	69.1	67.8	66.8	67.6	67.6	70.8	71.3	71.8	70.0	70.6	71.0	69.9		104.0
LOC SCHENECTADY	200	73.3	74.8	74.3	73.1	72.8	74.0	73.5	74.2	73.5	71.0	68.0	66.9		106.3
DATE 6/11/76	250	79.0	78.6	80.0	80.5	80.8	79.2	78.0	81.5	83.7	81.0	76.0	78.3		114.1
RUN 30/5	315	76.0	76.3	77.3	77.4	76.1	75.2	74.0	72.2	69.7	69.0	67.5	66.1		107.0
TAPE	400	77.8	77.5	76.5	76.6	75.1	74.7	73.5	72.2	68.7	68.8	66.3	63.3		106.3
BAR 30.0 MG	500	74.5	74.8	75.0	75.1	73.8	74.0	73.5	72.2	69.0	67.8	65.3	62.6		105.5
(0172. N/M2)	630	75.5	77.1	76.8	75.6	75.6	75.0	74.0	72.5	70.2	69.3	66.9	63.3		106.7
TAMB 85. DEG F	800	75.8	76.3	77.0	77.3	76.3	75.5	74.2	73.2	70.5	70.7	68.4	64.3		107.2
(303. DEG K)	1000	75.0	75.0	75.5	77.3	76.6	75.4	73.2	73.0	72.2	68.0	65.4	64.3		106.8
TWET 75. DEG F	1250	77.8	78.6	77.8	77.3	76.3	77.5	78.0	74.5	75.5	72.0	66.7	65.6		109.0
(297. DEG K)	1600	78.3	80.0	79.6	78.5	77.8	77.2	76.2	75.0	70.2	71.5	67.5	66.3		108.9
HACT 8.57 GM/M3	2000	80.3	81.5	82.6	80.9	81.3	80.7	81.0	80.5	74.7	77.2	69.3	72.5		112.8
(.01857 KG/M3)	2500	80.8	80.6	81.1	82.1	85.3	88.2	90.7	90.0	85.0	83.7	80.8	78.8		120.2
NFA 14205. RPM	3150	85.8	86.1	83.8	85.1	91.3	96.9	98.9	98.7	95.5	91.1	88.1	87.0		126.6
(1487. RAD/SEC)	4000	91.0	95.8	93.7	97.8	100.9	107.8	109.1	106.9	101.9	99.3	95.8	98.4		137.9
NFK 13862. RPM	5000	95.7	96.7	97.6	99.0	101.6	109.7	112.0	109.1	105.1	101.7	99.8	97.8		140.4
(1451. RAD/SEC)	6300	94.5	93.4	93.7	97.0	98.6	102.9	107.4	105.3	101.4	99.2	94.6	91.0		135.9
NFD 16100. RPM	8000	93.1	94.1	94.6	97.0	96.9	98.1	102.3	101.1	97.9	94.3	90.5	88.6		131.9
(1686. RAD/SEC)	10000	102.6	105.4	105.7	107.8	108.2	109.3	107.5	106.9	101.6	97.9	95.0	92.3		139.5
NO. OF BLADES 44	12500	94.6	94.9	96.3	98.5	99.6	100.1	102.5	101.1	96.8	93.3	90.7	85.9		132.7
FAN TIP SPEED	16000	92.5	93.4	94.8	96.9	98.0	99.9	100.6	99.0	94.5	90.9	87.1	82.9		131.3
1230. FT/SEC	20000	94.2	94.7	96.2	97.2	96.4	100.3	99.1	96.7	91.7	87.4	83.8	79.7		131.0
	25000	90.4	90.5	92.1	93.5	94.6	96.8	96.8	94.2	89.6	84.4	80.9	75.5		128.5
	31500	88.6	89.2	90.3	91.7	92.5	93.7	93.8	91.1	86.4	79.8	74.7	71.1		126.6
	40000	84.7	85.3	87.0	87.8	88.9	90.4	89.7	87.1	81.9	76.1	69.8	67.7		124.2
	50000	81.2	81.8	83.3	84.0	85.0	87.2	86.7	83.6	78.4	72.0	66.7	66.9		122.7
	63000	77.5	77.5	78.8	79.3	80.6	83.3	82.7	80.8	74.3	68.4	66.5	65.6		121.5
	80000	73.2	71.4	73.4	72.3	73.1	80.6	80.5	79.1	71.8	69.2	69.7	63.4		122.6
OVERALL CALCULATED		103.9	107.5	108.2	110.3	111.3	114.9	116.3	114.2	109.9	106.7	103.7	102.6		145.9

Table 33

MODEL SOUND PRESSURE LEVELS (59°F, 70% Relative Humidity, Day)

Angles from Inlet in Degrees (and Radians)

BASELINE CLEAN CHAMBER (REPEAT)

CORRECTED SPEED = 90%

RADIAL 12. FT. (5. M)
VEHICLE R-11
CONFIG CF 6
LOC SCHENECTADY
DATE 8/11/76
RUN 30/6
TAPE
BAR 30.0 MG (01172. N/M2)
TAMB 85. DEG F (303. DEG K)
TWET 74. DEG F (296. DEG K)
HACT 17.61 GM/M3 (.01761 KG/M3)
NFA 14848. RPM (1555. RAD/SEC)
NFK 14489. RPM (1517. RAD/SEC)
NFD 16100. RPM (1686. RAD/SEC)
NO. OF BLADES 44
FAN TIP SPEED 1286. FT/SEC

FREQ.	0. (0.)	10. (0.17)	20. (0.35)	30. (0.52)	40. (0.70)	50. (0.87)	60. (1.05)	70. (1.22)	80. (1.40)	90. (1.57)	100. (1.75)	110. (1.92)	0. (0.)	0. (0.)
													PWL	
50														
63														
80														
100	68.1	64.6	65.8	64.4	70.3	70.8	71.0	71.0	70.0	70.3	69.8	69.1	103.6	
125	70.1	69.5	70.8	67.9	70.3	70.8	72.0	71.8	70.8	72.1	71.3	70.4	104.8	
160	67.8	66.3	66.0	66.1	70.5	70.8	71.3	72.0	70.3	71.1	71.8	70.6	104.4	
200	70.6	71.8	71.0	69.9	72.7	72.5	73.0	71.2	67.5	68.0	67.0	63.9	104.0	
250	76.5	78.3	76.5	77.1	76.7	78.2	79.7	78.7	79.7	82.5	81.0	74.1	113.1	
315	75.5	75.3	73.8	73.9	73.7	73.5	72.2	70.7	67.2	68.0	67.3	64.6	104.8	
400	74.5	73.5	73.3	73.1	73.2	72.5	71.7	70.2	66.7	67.0	65.1	61.8	104.0	
500	73.3	72.5	72.8	72.6	73.8	74.0	72.5	70.2	67.7	65.8	64.3	63.6	104.3	
630	80.5	80.1	79.0	77.6	76.5	77.2	73.5	71.8	67.7	67.0	64.9	63.6	107.0	
800	75.5	74.8	74.8	74.8	75.0	74.2	73.5	73.2	70.0	69.0	66.4	63.1	105.9	
1000	75.3	73.5	73.0	74.3	76.2	75.9	73.2	74.2	72.9	69.2	68.4	68.3	106.8	
1250	77.5	76.6	76.3	78.1	80.3	81.5	81.0	81.5	80.2	75.5	72.4	72.1	112.7	
1600	80.6	81.6	82.1	83.9	86.5	90.2	90.5	88.3	84.2	82.7	82.0	81.3	120.2	
2000	85.3	85.1	86.3	85.9	95.2	100.2	102.2	100.0	96.7	94.5	94.0	91.0	131.2	
2500	80.1	85.1	84.8	87.6	95.2	98.7	100.4	98.8	94.7	95.2	90.6	89.0	129.9	
3150	85.5	89.1	83.3	84.6	95.4	99.6	100.1	98.0	94.2	89.4	88.8	87.0	129.4	
4000	89.2	90.3	90.7	97.8	104.1	107.6	106.8	103.9	100.7	97.3	97.3	95.9	136.6	
5000	94.9	95.4	95.9	98.5	106.8	111.5	111.2	107.1	103.8	100.0	100.3	99.1	140.3	
6300	94.5	93.7	96.2	96.0	100.3	106.9	108.9	105.1	101.9	99.9	94.8	93.8	137.3	
8000	92.3	93.3	93.5	96.8	97.6	102.6	103.6	101.1	96.9	93.6	90.7	88.6	132.9	
10000	105.9	104.7	105.9	107.1	107.3	107.8	110.5	107.6	103.9	100.7	96.0	96.0	140.1	
12500	100.1	99.2	100.3	102.0	103.0	103.3	106.0	102.9	99.1	95.1	92.0	89.5	135.6	
16000	95.3	93.7	95.3	97.9	99.7	100.4	102.3	99.0	95.3	90.4	87.4	83.4	132.3	
20000	95.8	95.0	96.0	98.0	98.9	99.9	100.6	98.0	93.5	89.0	85.1	81.5	131.7	
25000	91.2	91.8	93.1	94.6	96.1	97.6	98.9	96.0	90.9	86.0	82.2	77.3	130.0	
31500	88.2	89.0	90.3	92.6	93.0	94.8	95.3	92.4	87.3	82.1	76.8	72.9	127.7	
40000	84.1	85.2	86.4	88.0	89.7	91.3	91.8	89.2	83.3	77.2	71.7	69.6	125.5	
50000	81.4	81.4	83.0	85.2	86.6	88.9	89.1	87.0	80.8	74.6	68.7	68.3	124.7	
63000	78.0	77.8	78.8	79.9	82.7	85.3	85.5	83.6	77.6	70.4	67.0	67.1	123.7	
80000	73.6	71.6	73.7	73.6	79.6	81.3	81.9	80.2	73.6	69.5	70.0	64.0	124.0	
OVERALL CALCULATED	108.2	107.6	108.7	110.4	113.0	116.1	117.1	113.9	110.3	107.2	105.0	103.7	146.6	

Table 34

MODEL SOUND PRESSURE LEVELS (59°F, 70% Relative Humidity, Day)

Angles from Inlet in Degrees (and Radians)

BASELINE CLEAN CHAMBER (REPEAT)

CORRECTED SPEED - 100%

RADIAL 17. FT. (5. M)
VEHICLE R-11
CONFIG CF 6
LOC SCHENECTADY
DATE 8/11/76
RUN 307Z
TAPE
BAR 30.0 HG (01172. N/M2)
TAMB 85. DEG F (303. DEG K)
TMET 74. DEG F (296. DEG K)
HACT17.6. GM/M3 (.01751 KG/M3)
NFA 16499. RPM (1727. RAD/SEC)
NFK 16100. RPM (1686. RAD/SEC)
NFD 16100. RPM (1686. RAD/SEC)
NO. OF BLADES 44
FAN TIP SPEED 1429. FT/SEC

FREQ.	0. (0.)	10. (0.17)	20. (0.35)	30. (0.52)	40. (0.70)	50. (0.87)	60. (1.05)	70. (1.22)	80. (1.40)	90. (1.57)	100. (1.75)	110. (1.92)	0. (0.)	0. (0.)
50													PWL	
63														
80														
100	64.1	63.8	64.0	63.4	70.3	70.8	71.0	71.5	71.0	72.1	71.5	71.1	104.5	
125	67.3	66.3	69.8	65.4	70.3	70.8	71.8	72.8	73.0	74.3	74.0	73.1	106.2	
160	69.1	66.8	66.0	65.4	70.3	70.8	72.3	73.5	73.8	74.6	75.8	74.1	106.9	
200	64.3	65.8	66.8	67.9	71.7	71.5	72.0	70.7	74.3	64.5	64.3	62.4	102.4	
250	84.0	87.8	89.8	91.9	90.0	85.7	81.7	80.0	81.0	81.0	79.3	79.1	119.0	
315	79.8	83.0	85.5	87.4	85.5	81.7	78.0	76.0	77.0	77.3	75.5	75.1	114.7	
400	65.3	66.0	67.3	69.1	70.7	70.7	71.0	70.2	64.2	65.3	63.8	61.1	101.9	
500	65.0	66.5	69.8	71.8	72.0	75.0	75.0	78.2	74.7	68.5	68.6	62.3	107.2	
630	66.5	69.3	70.3	70.6	72.0	73.5	73.7	76.0	72.5	67.5	67.1	62.8	105.6	
800	70.5	69.3	68.8	69.8	72.0	73.7	74.2	74.5	73.2	75.0	74.6	73.6	107.4	
1000	76.0	75.5	81.8	86.5	88.0	88.2	91.2	90.5	90.9	85.7	85.1	82.3	122.0	
1250	80.0	79.6	82.6	90.1	95.0	95.2	96.5	95.8	92.7	90.7	86.9	85.1	126.8	
1600	85.6	82.1	91.6	96.4	100.5	101.2	102.5	99.8	97.0	95.5	95.2	92.8	132.3	
2000	82.6	82.8	89.1	94.1	100.5	102.4	103.0	99.5	97.5	96.5	92.8	90.3	132.5	
2500	89.6	84.1	90.3	90.9	98.2	102.7	103.2	101.3	96.5	94.9	92.6	87.3	132.4	
3150	84.3	82.6	83.0	85.9	91.4	95.1	94.4	91.7	88.5	86.4	84.3	78.7	124.2	
4000	84.7	85.5	86.2	87.8	93.6	95.6	93.3	90.2	87.7	85.5	85.1	80.1	124.2	
5000	93.4	94.2	94.1	98.0	105.8	108.2	104.2	102.1	98.8	95.5	97.3	90.6	136.1	
6300	94.0	94.7	95.0	98.5	102.3	106.6	104.7	104.3	101.9	97.7	94.6	91.5	135.9	
8000	93.3	93.6	94.5	95.0	98.6	103.6	101.1	97.4	94.4	91.3	89.0	86.4	131.6	
10000	96.6	99.7	99.9	101.6	101.3	103.8	102.0	99.6	96.6	92.4	90.0	88.3	133.5	
12500	109.9	107.4	107.8	109.0	109.3	111.6	109.5	107.6	103.1	98.3	97.0	93.0	141.3	
16000	94.3	95.2	96.8	98.2	99.7	101.2	100.1	96.7	93.3	89.2	86.4	82.9	131.4	
20000	93.0	94.2	95.0	97.2	98.1	99.6	98.6	95.5	92.0	87.7	84.1	80.5	130.4	
25000	95.2	95.0	96.1	97.3	97.8	99.6	99.1	96.2	92.1	86.7	82.7	78.5	131.3	
31500	88.5	89.3	91.3	92.6	93.8	96.0	95.1	91.4	86.8	81.3	75.8	72.4	128.0	
40000	86.1	86.2	87.4	89.2	90.7	93.1	92.3	88.7	84.3	78.0	71.7	68.6	126.4	
50000	81.9	82.4	84.0	85.4	87.4	89.6	88.9	85.0	80.1	74.1	68.2	65.6	124.7	
63000	77.5	77.8	79.3	80.6	83.2	86.3	85.0	81.1	76.9	70.2	67.0	64.6	123.6	
80000	72.8	71.8	73.7	74.1	79.9	82.0	81.4	79.5	72.6	69.5	70.0	62.5	123.9	
OVERALL CALCULATED	106.7	109.3	110.0	111.6	113.5	116.0	114.4	112.3	108.9	105.5	103.9	100.2	145.7	

Table 35

MODEL SOUND PRESSURE LEVELS (59°F, 70% Relative Humidity, Day)

Angles from Inlet in Degrees (and Radians)

BASELINE CLEAN CHAMBER (REPEAT)
CORRECTED SPEED - 86% (REPEAT)

RADIAL 17. FT.
(5. M)
VEHICLE R-11
CONFIG CF 6
LOC SCHENECTADY
DATE 8/11/76
RUN 30/8
TAPE
BAR 30.0 HG
(01172. N/M2)
TAMB 86. DEG F
(303. DEG K)
TWET 74. DEG F
(296. DEG K)
HACT17.31 GM/M3
(.01731 KG/M3)
NFA 14201. RPM
(1487. RAD/SEC)
NFK 13845. RPM
(1450. RAD/SEC)
NFD 16100. RPM
(1686. RAD/SEC)
NO. OF BLADES 44
FAN TIP SPEED
1230. FT/SEC

FREQ.	0. (0.)	10. (0.17)	20. (0.35)	30. (0.52)	40. 0.70	50. (0.87)	60. (1.05)	70. (1.22)	80. (1.40)	90. (1.57)	100. (1.75)	110. (1.92)	0. (0.)	0. PWL
50														
63														
80														
100	68.1	67.6	68.0	66.4	65.1	70.8	71.8	72.0	71.3	72.1	71.3	69.4		104.4
125	71.6	71.3	71.8	69.1	67.3	70.8	72.3	71.6	70.8	72.1	70.8	69.9		104.7
160	68.8	67.8	66.8	67.4	67.6	70.8	71.0	71.3	69.5	69.6	70.8	69.4		103.6
200	72.6	74.3	73.8	73.1	72.8	73.7	73.5	74.2	74.0	71.5	67.8	69.1		106.4
250	79.0	78.8	80.0	80.4	80.6	79.2	78.0	82.2	84.2	81.5	77.0	78.3		114.5
315	76.3	76.5	77.0	76.6	75.6	75.0	73.5	72.7	69.5	68.8	67.3	66.3		106.8
400	77.8	77.3	76.3	76.3	75.1	74.7	73.7	71.7	69.0	68.8	66.3	63.6		106.3
500	75.0	74.8	75.0	75.1	74.3	74.2	73.7	72.5	68.7	67.5	65.3	62.6		105.6
630	75.3	76.8	76.8	76.8	75.3	74.7	74.0	72.5	69.7	69.0	66.9	63.1		106.6
800	75.3	76.0	76.3	76.8	76.1	75.2	74.2	73.0	70.2	70.0	67.9	64.1		106.9
1000	75.3	75.3	76.3	77.0	76.3	75.4	73.5	73.0	71.9	68.0	65.1	64.8		106.8
1250	78.5	78.8	78.1	78.1	77.1	78.2	78.2	75.0	76.2	72.5	67.7	66.6		109.5
1600	78.1	80.8	80.1	79.4	79.1	77.7	76.2	74.8	70.2	70.7	66.7	66.6		109.3
2000	79.6	81.1	82.3	80.6	81.1	80.7	81.0	80.5	74.7	77.0	69.3	72.8		112.7
2500	80.8	81.3	81.6	83.9	86.1	89.7	91.9	91.0	86.2	85.2	82.1	80.0		121.4
3150	85.8	86.1	84.5	85.9	91.3	97.1	99.1	98.5	96.0	91.4	88.6	87.5		128.8
4000	90.7	95.3	93.0	98.3	99.9	107.8	108.8	106.9	101.4	99.3	95.1	98.4		137.8
5000	95.7	96.4	97.4	99.5	01.6	109.7	112.0	109.4	104.8	101.7	99.8	97.8		140.4
6300	94.3	92.9	93.2	97.3	98.4	102.9	107.4	105.6	101.4	99.4	94.6	90.8		136.0
8000	92.8	93.8	94.5	97.0	96.7	98.1	102.3	101.4	97.6	93.8	90.7	88.1		131.9
10000	102.4	104.9	106.2	107.5	108.2	108.8	107.5	106.1	101.6	97.7	95.0	92.3		139.2
12500	94.1	95.4	95.8	98.0	99.4	100.6	102.2	101.1	97.4	93.6	90.7	85.7		132.7
16000	92.8	93.5	94.9	97.4	98.3	99.7	100.6	99.3	95.0	91.4	87.2	83.2		131.5
20000	94.1	95.3	95.7	98.3	99.0	100.6	98.9	96.5	91.8	87.7	83.4	79.8		131.1
25000	90.0	90.6	92.2	93.6	94.2	97.1	96.7	93.5	89.9	84.2	80.5	76.3		128.5
31500	89.0	89.3	90.4	92.1	92.4	93.8	93.4	91.2	86.1	79.4	74.4	71.2		126.6
40000	84.7	85.8	86.9	88.3	88.8	90.6	90.1	87.3	82.6	75.8	70.0	67.7		124.5
50000	81.3	81.8	83.6	84.5	85.6	86.7	87.0	83.9	79.2	71.7	67.3	66.7		122.8
63000	77.2	77.5	79.0	79.3	81.0	83.2	82.9	80.7	75.5	68.6	66.9	66.2		121.6
80000	72.3	71.7	73.9	73.1	73.6	81.2	81.1	79.7	72.6	69.7	70.2	63.5		123.2
OVERALL CALCULATED	105.7	107.5	108.4	110.3	11.2	114.8	116.2	114.2	109.8	106.7	103.6	102.6		145.8

Table 36

MODEL SOUND PRESSURE LEVELS (59°F, 70% Relative Humidity, Day)

Angles from Inlet in Degrees (and Radians)

BASELINE CLEAN CHAMBER (REPEAT)
CORRECTED SPEED - 69% (REPEAT)

RADIAL 17. FT. (5. M)
VEHICLE R-11
CONFIG CF 6
LOC SCHENECTADY
DATE 8/11/76
RUN 30/9
TAPE
BAR 30.0 HG (01172. N/M2)
TAMB 86. DEG F (303. DEG K)
TWET 75. DEG F (297. DEG K)
HACT 18.27 GM/M3 (.01827 KG/M3)
NFA 11393. RPM (1193. RAD/SEC)
NFK 11108. RPM (1163. RAD/SEC)
NFD 16100. RPM (1686. RAD/SEC)
NO. OF BLADES 44
FAN TIP SPEED 967. FT/SEC

FREQ.	0. (0.)	10. (0.17)	20. (0.35)	30. (0.52)	40. (0.70)	50. (0.87)	60. (1.05)	70. (1.22)	80. (1.40)	90. (1.57)	100. (1.75)	110. (1.92)	0. (0.)	0. (0.) PWL
50														
63														
80														
100	72.0	72.0	70.8	69.6	67.6	68.0	70.5	71.0	70.7	70.6	70.2	69.0		103.8
125	75.7	76.0	75.1	72.9	71.8	71.5	73.0	72.3	72.4	73.1	72.2	71.8		106.4
160	71.5	71.0	68.8	70.1	70.1	69.8	68.0	69.3	68.7	68.6	69.2	68.0		102.8
200	74.2	76.5	75.6	74.1	73.3	73.5	72.8	71.5	68.4	69.6	71.2	71.5		106.0
250	80.5	80.3	79.8	79.6	77.8	75.8	74.7	72.5	72.2	72.1	70.9	68.3		108.8
315	82.0	81.8	81.3	80.1	79.3	77.3	75.5	74.0	71.9	71.1	69.7	68.5		109.7
400	78.7	78.8	78.6	77.6	76.3	74.8	73.5	71.0	69.2	68.3	66.7	63.8		107.0
500	75.7	76.0	76.6	75.6	74.6	73.5	72.7	70.8	68.9	68.1	65.0	63.0		105.5
630	78.0	78.5	78.3	77.8	76.6	75.0	73.5	71.5	70.1	69.1	67.7	64.3		107.2
800	77.9	78.0	77.6	76.1	77.1	74.7	73.2	71.0	69.1	68.8	67.7	64.2		107.0
1000	73.9	74.8	75.1	75.5	75.1	73.2	71.7	70.3	67.1	63.3	64.5	63.2		104.9
1250	73.5	74.9	75.4	75.3	73.8	72.2	70.2	67.6	65.9	64.3	62.1	60.2		104.0
1600	74.7	75.3	75..	74.6	73.8	72.7	71.2	68.1	65.2	64.0	61.9	60.5		104.1
2000	77.5	78.1	77.9	77.4	77.8	76.0	74.0	70.3	67.2	65.3	63.7	62.7		107.1
2500	79.0	78.8	79.9	80.2	79.3	77.7	76.7	72.6	69.9	67.2	66.2	63.9		109.1
3150	81.2	80.6	80.8	81.6	80.8	79.9	78.4	75.0	72.1	69.2	68.5	66.7		110.9
4000	83.4	84.0	83.8	84.1	83.4	83.4	82.1	78.0	74.8	73.1	70.4	69.3		113.9
5000	83.6	84.4	85.2	85.5	85.9	85.5	85.0	80.9	78.0	75.8	73.4	71.0		116.2
6300	85.2	85.7	87.3	88.7	88.4	88.2	86.2	82.9	78.6	76.2	73.9	72.2		118.4
8000	94.8	96.1	97.8	101.8	104.4	105.9	104.6	101.2	96.6	93.9	91.4	88.6		135.1
10000	87.5	88.7	89.5	92.6	93.2	94.6	93.0	89.7	85.1	81.7	80.2	77.7		124.1
12500	87.0	88.2	89.6	90.3	90.6	90.6	90.2	85.2	80.8	77.1	75.8	73.1		121.3
16000	99.2	94.7	94.6	97.1	97.5	98.2	97.1	93.8	88.2	84.7	81.8	79.1		128.8
20000	88.2	88.2	89.2	91.2	91.0	91.1	89.6	85.5	79.7	75.8	73.2	70.2		122.2
25000	86.6	87.8	91.4	94.1	93.4	93.8	92.4	88.5	82.8	77.0	74.8	71.9		125.5
31500	83.3	84.7	87.1	89.5	90.3	90.0	88.3	84.2	76.9	70.8	67.4	64.1		122.4
40000	79.7	80.6	83.1	85.1	85.9	86.3	83.8	79.7	72.7	66.7	62.0	60.2		119.6
50000	75.5	76.3	78.7	81.1	81.9	82.3	80.5	75.7	68.2	63.1	58.9	58.6		117.5
63000	71.3	71.7	74.0	76.5	77.4	78.2	76.4	71.2	64.9	60.4	57.3	57.9		115.9
80000	65.5	64.6	67.1	71.0	71.0	71.6	71.0	69.3	61.9	59.7	54.0	55.3		114.4
OVERALL CALCULATED	101.9	100.8	102.0	104.9	106.4	107.5	106.2	102.8	98.0	95.2	92.8	90.1		137.4

Appendix III

REFERENCES

1. Feiler, C.E., and Merriman, J.E.: Effects of Forward Velocity and Acoustic Treatment on Inlet Fan Noise. NASA TM X-71591, 1974 (also AIAA Paper No. 74-946).

2. Merriman, J.E., and Good, R.C.: Effect of Forward Motion on Fan Noise. Paper No. 75-464, AIAA 2nd Aero-Acoustics Conference, 1975.

3. Roundhill, J.P., and Schaut, L.A.: Model and Full Scale Test Results Relating to Fan Noise In-Flight Effects. Paper No. 75-465, AIAA 2nd Aero-Acoustics Conference, 1975.

4. Kazin, S.D., and Volk, L.J.: LF336 Lift Fan Modification and Acoustic Test Program. NASA CR-1934, 1971.

5. Hodder, B.K.: The Effects of Forward Speed on Fan Inlet Turbulence and Its Relation to Tone Noise Generation. NASA TM X-62381, 1974.

6. Lowrie, B.W.: Simulation of Flight Effects on Aero Engine Fan Noise. Paper No. 75-463, AIAA 2nd Aero-Acoustics Conference, 1975.

7. Cumpsty, N.A., and Lowrie, B.W.: The Cause of Tone Generation by Aero-Engine Fans at High Subsonic Tip Speeds and the Effect of Forward Speed. ASME J. Eng. Power, vol. 96, no. 3, 1974, pp. 228-234.

8. Povinelli, F.P., Dittmar, J.H. and Woodward, R.P.: Effects of Installation Caused Flow Distortion on Noise from a Fan Designed for Turbofan Engines. NASA TN D-7076, 1972.

9. Hodder, B.K.: Investigation of the Effect of Inlet Turbulence Length Scale on Fan Discrete Tone Noise. NASA TM X-62300, 1973.

10. Hanson, D.B.: The Spectrum of Rotor Noise Caused by Atmospheric Turbulence. J. Acoust. Soc. of America, vol. 56, no. 1, 1974, pp. 110-126.

11. Hanson, D.B.: Measurements of Static Inlet Turbulence. Paper No. 75-467, AIAA 2nd Aero-Acoustics Conference, 1975.

12. Hanson, D.B.: A Study of Subsonic Fan Noise Sources. Paper No. 75-468, AIAA 2nd Aero-Acoustics Conference, 1975.

13. Pickett, G.F.: Effects of Non-Uniform Inflow on Fan Noise. Acoust. Soc. of America, Spring Meeting, New York, April 1974.

14. Hodder, B.K.: An Investigation of Possible Causes for the Reduction of Fan Noise In Flight. Paper No. 76-585, AIAA 3rd Aero-Acoustics Conference, 1976.

15. Goldstein, M., Unified Approach to Aerodynamic Sound Generation in the Presence of Solid Boundaries, J. Acoust. Soc. of America, vol. 56, no. 2, 1974, pp. 497-509.

16. Goldstein, M., Dittmar, J., and Gelder, T., A Combined Quadrupole-Dipole Model for Inlet Flow Distortion Noise from a Subsonic Fan. NASA TN D-7676, 1974.

17. Mani, R.: Noise Due to Interaction of Inlet Turbulence with Isolated Stators and Rotors. J. Sound Vib. vol. 17, no. 2, 1971, pp. 251-260.

18. Mani, R.: Isolated Rotor Noise Due to Inlet Distortion or Turbulence. NASA CR-2479, 1974.

19. Mani, R., and Bekofske, K., Experimental and Theoretical Studies of Subsonic Fan Noise. NASA CR-2660, 1976.